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AN

INAUGURAL DISSERTATION

ON THE

CONGENITAL MALFORMATIONS

OF THE

HEART.

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"All Nature is but art unknown to thee;
All chance, direction which thou canst not see;
All discord harmony not understood."

POPE.

"L'ordre est dans le désordre."

SERRES.

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MDCCCXXXI.

TO

JAMES MACARTNEY, M. D. F. R. S.

&c. &c. &c.

AND

PROFESSOR OF ANATOMY AND SURGERY IN THE UNIVERSITY OF

DUBLIN,

UNDER WHOSE AUSPICES

THE AUTHOR FIRST ENTERED ON THE STUDY OF HIS PROFESSION,

THESE FIRST FRUITS

OF HIS STUDIES

ARE

MOST RESPECTFULLY DEDICATED.

PREFACE.

As the Senatus of the University of Edinburgh have decreed that the publication of the Thesis in Latin shall no longer be required for Graduation, I have chosen to present my Inaugural Dissertation to my friends in its English dress, considering it as more likely in this form to be generally useful and acceptable. But I feel that no apology can be needed for neglecting a custom, which has only its antiquity to urge in its behalf.

The subject of Congenital Malformation has, for some time, formed a favourite object of study with the continental physiologists, and the results at which they have arrived, have amply repaid them for their labour. In our own country, however, we have still to lament that the attention of the medical profession has rarely, if ever, been called to the study of Monstrosity, in relation to any of the important doctrines of physiology, with which it is so closely connected. Our anatomists

seem to have contented themselves with the description of a single monster, and to have considered it interesting but in proportion to the rarity of its occurrence, without reflecting that it is only in the generalization of extraordinary facts that they become of use to the philosopher, or available to the cause of science.

Should these pages be the means of inviting the attention of any of my countrymen to the Principles and Laws which regulate the Developement of Monstrosity, a subject so fertile in itself, so important in its general relations, my object in their publication will be more than fulfilled.

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THE

CONGENITAL MALFORMATIONS

OF THE

HEART.

Part I.

Developement and Classification of Malformations.*

IT is no long time since the opinion that "monsters prove nothing," was advanced by the physiologist as an incontrovertible axiom. A *lusus naturæ*, as such phenomenon was designated, was supposed so completely to set at defiance all the ordinary laws of nature, that not only could no elucidation of these laws be derived from such anomalies, but the very causes on which their formation depended, were thought to be entirely distinct. The falsity of such a doctrine is now sufficiently established. "L'ordre est dans le désordre," are the words of M. Serres, concisely expressing the important truth, that the same laws preside alike over formation and malformation, and that it is only in the more perfect knowledge of these laws, that we can look for a full explanation of such appearances.

The German anatomists seem to have been the first, to attempt the study of monsters on anything like philosophical principles.

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* This dissertation will appear in its present form, in the Edinburgh Medical and Surgical Journal.

Sœmmering, Walter, Meckel, and Tiedemann, have enlisted their talents in the cause, and the French, with St Hilaire, Serres, Breschet, Andral fils, amidst a host of others, have engaged in the same pursuit. The importance of the physiological facts exhibited by monsters, has formed for these authors the first attraction; Meckel sees in them, proofs of the gradual developement of different organs; St Hilaire derives from them, arguments in favour of unity of organization; while Serres proves, from the same prolific sources, that the formation of the body takes place from the circumference to the centre. These doctrines have again reacted on our present subject, which, when studied in relation to the splendid discoveries of modern anatomists, as of unity of organization and progressive developement, becomes, from an unintelligible mass of confusion, a beautiful object of scientific research.

It is not our intention to enter at length, on the subject of monstrosity in general; but as the same causes must produce the malformation of a single organ as of many, (to which the term monster has been commonly applied,) we may be allowed to say a few words on the causes to which they have been attributed, and the laws which are supposed to regulate their formation. Should we, in the course of these pages, venture to differ in opinion with those whose names we must always hold in the greatest reverence, it is because when, after mature deliberation, we have been unable to agree with them, we think it most respectful openly to express our dissent, actuated by the hope of eliciting further information on points of such difficulty and importance.

St Hilaire was among the first to overturn the absurd doctrines, more wild, if possible, than the freaks attributed to dame Nature herself, which were for a long time entertained as to the causes of monstrosity. Popular credulity alone, now adheres to the belief that mental emotions furnish the only exciting cause, and wonderful indeed are the tales adduced to support it. After disproving this fallacy, however, as well by observation on man as by the most conclusive experiments on eggs, M. Geoffroy * demands an equal universality of influence for external

* Philosophie Anatomique des Monstruosités Humaines, p. 474 à 541.

and corporeal injuries. These, he says, occurring during fœtation, produce adhesions between the placenta and embryo, whereby the circulation to a particular part or parts is affected, and the growth modified accordingly. This we might imagine to operate as far as regards the malformation of an extremity, or some part to which the effect of the adhesion might extend; but how it can act in producing an imperfect *septum ventriculorum*, or an open *foramen ovale*, we must confess we can scarcely see, and cannot therefore allow it, as the general exciting cause of congenital malformation.

M. Serres * has imagined that he has discovered, if not the cause, at least the manner, in which malformation is produced. He conceives that every artery has its own specific function, and that the developement of every part depends immediately on the presence of the artery proper to that part; as, for instance, that of the cerebrum on the internal carotid; or that of the cerebellum on the vertebral; and consequently, that when any artery fails, the part which it ought to supply is also deficient. When, on the contrary, there are additional parts formed, as supernumerary arms or legs; these, he says, must be supplied by branches corresponding to the arteries natural to the part. In proof of this, he adduces the case † of a monstrous kitten, in which there was an additional upper extremity protruding from under the chin, and an axillary artery was found creeping under the skin of the neck to supply its nutriment, and account for its existence.

It is for this reason, according to the same author, that a certain relation is observed in the formation of supernumerary parts, for which it would be otherwise difficult to account. We never see, says he, an additional head or arm protruding from the sacrum or pelvis, nor a supernumerary leg or part of the genital organs from the superior part of the trunk, because the artery on which the formation of such part depends, cannot take so long and unnatural a course. This, though perhaps the best argument in favour of the theory, is by no means well

* Arch. Générales de Médecine, Tom. xvi. Mémoires du Museum de l'Hist. Nat. Tom. xiii.

† Mémoires du Museum de l'Hist. Nat. Tom. xv. p. 420.

established. * That an artery will generally be absent, when the part to the nourishment of which it should be appropriated is wanting, is sufficiently probable; but it may well admit of doubt, whether the former deficiency be the cause or merely the effect of the latter, especially as we find the rudiments of many parts before there is any trace of a vascular system.

Tiedemann, † proceeding on the hypothesis that the nervous system precedes and regulates the developement of the rest of the body, imagined that he had discovered the cause of monstrosity, in the defective or excessive developement of this system. ‡

This theory, however, is scarcely more tenable than that of M. Serres; for though the relation between the excessive and defective parts, and their nerves, as well as their arteries, generally holds, yet it is far from universal; and we have accordingly, sometimes entire absence of the brain and spinal marrow, with a body otherwise nearly perfect; § at others, a cranium complete in all its parts, while the brain is absent, ‖ as well as innumerable other examples of malformation quite inexplicable on these principles.¶ The remark of Cuvier, ** in an analysis of the work of M. Serres, is equally applicable to either opi-

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* A case scarcely reconcilable with this opinion is detailed in Tiedemann's Zeitschrift für Physiologie, Band. iii. p. 6.

† Arch. Gén. de Méd. Tom. xii. p. 614.

‡ Zeitschrift für Physiologie, 3e cahier, 1828.

§ Arch. Gén. de Méd. Tom. xx. p. 454, and MS. Catalogue of the Hunterian Museum, Glasgow, M. *m.* 8.

‖ Philos. Anat. des Monst. Humaines (Anencephalie) p. 38.

¶ Though unwilling to dwell at greater length on this part of the subject than is absolutely necessary, we cannot resist quoting a case related by Professor Mayer (Graefe und Walther's Journ. Tom. x. cah. 2.) of a heteradelphe monster, as it so completely contradicts the hypotheses both of Serres and Tiedemann. A fœtus of natural size was furnished with a parasite attached to the sternum, and consisting only of a *pelvis and well-formed lower extremities.* The blood by which the parasite was nourished, was entirely derived from the *internal mammary artery* of the principal fœtus, which afterwards dividing into two femorals, was distributed to the limbs. *There was no appearance whatsoever of a cerebro-spinal nervous system; the sciatic, crural,* and *obturator nerves were wanting,* and no filaments could be observed distributed to the muscles. A renal and mesenteric plexus sending off a small twig accompanying the crural artery, were the only parts of the nervous system which could be discovered.

** Analyse des Travaux de l'Acad. Royale des Sciences, année 1825, p. 34.

nion, " On sent qu'il reste toujours à se demander pourquois les artères se multiplient,"—and we fear the question must long remain unanswered.

But we leave these difficult questions of ultimate and proximate causes, to pursue what appears to us a more interesting part of the inquiry,—the laws by which the formation of monsters are regulated, and the possibility of submitting them to a strictly natural arrangement.

At the very commencement of the study of monstrosities, we are struck by the amazing variety of form they present,—by the apparent want of connection between their various parts,—and at times, by the absence of those very parts, the presence of which we have been taught to consider as essential to formation itself. To reduce these objects to a classification analogous to that under which we arrange the various grades of animal or vegetable life, and to adapt to these a scientific nomenclature, was a beautiful conception, worthy of the genius of St Hilaire. Greatly, however, as this would facilitate the study and increase our knowledge of the subject, and anxiously as we should therefore desire its accomplishment, we fear it can never be attained. Our reason for this opinion is founded on the belief, that the separate parts of the body do not in the monster, as in the natural animal, bear any certain and fixed relation to each other. To illustrate this, let us take St Hilaire's * definition of an anencephalous monster, " Point de cerveau ni de moelle épinière ; la face et tous les organes des sens dans l'état normal ; la boîte cérébrale ouverte vers la ligne médiane, et composée de deux moitiés renversées et écartées de chaque côté en ailes de pigeon." We have here a reference only to the form, number, and relation of the parts of the cranium and its contents ; but in what state are the other parts of the body ? In all cases agreeing with this definition they ought to be the same, or it ceases to possess the proper generic characters. Now, in one case of a monster of this kind, we may have the heart entirely wanting, and perhaps many other organs deficient ; in a second † the extremities are but imperfectly formed,

* Philosophie Anatomique des Monst. Humaines, 1822, p. 88

† MS. Cat. of the Hunterian Museum, Glasgow, M. *m.* 15.

while in a third * the body is in other respects nearly natural. If, again, the heart, or any other part of the body, be taken to furnish the generic character, similar anomalies will constantly present themselves. In monsters presenting a greater number of parts than natural, these contradictions are still more evident; and there is perhaps scarcely one of the divisions proposed by M. Isidore St Hilaire † in his arrangement of monsters of excess, to which many striking exceptions might not be easily opposed.

The error into which these authors have fallen, seems to have arisen from believing too firmly, in the necessary connection and sympathy of different parts of the same body. Indissoluble and essential as this connection may be at a later period of existence, we are strongly inclined to think it does not exist during the formation of parts. Tiedemann, as we have seen, takes the nervous system, Serres the vascular, and each considers the perfection of this as necessary to the perfection of the whole, or of any part. The dissection of many monsters, has sufficiently proved neither of these systems indispensable. We find, on the contrary, the presence or absence of one part, even the most important, does not indicate the same state of any other, that an acephalous monster may possess a perfect heart, ‡ and an acardious fœtus a nervous system perfectly natural; § that a monocephalous animal may have two hearts, || while a bicephalous monster has but a single imperfect one. ¶ The occurrence of instances like the one last quoted has led authors, as St Hilaire, Andral fils, and even Breschet, ** to suppose that there exists a certain balance in the anormal formation of parts, that one part is developed in excess at the expence of some other, which must consequently exhibit a malformation of defect. Now, willing as we are to admit the force of this beautiful law in the grada-

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* Arch. Gén. de Méd. Tom. xx. p. 454.

† Annales des Sciences Nat. Tom. p. 336.

‡ M. Breschet alludes to two cases of this description in the Dict. de Méd. Art. Acéphale, p. 272.

§ Philos. Trans. 1809, Part I. p. 161.

|| Meckel, Dissertatio Inaug. de Cordis Conditionibus Abnormibus, Halle, 1802, p. 8.

¶ Catal. of Anat. Museum, University of Edinburgh. 2. G. 9.

** Dict. de Méd. Art. Déviations Organiques.

tions of animal life,—witness the kangaroo, the ostrich, &c. &c. or even in the after-growth of different parts of an individual body,—the arms of the blacksmith and head of the student, may perhaps lend weight to the opinion ; yet we venture to deny, that any such relation can be made out in the developement of monstrosity. Many more instances might be adduced to controvert, than to confirm such an hypothesis. *There is then little sympathy, and no absolute connection, during formation, in the developement of different parts of the same body.*

These considerations have led us to believe that each system of organs, if not each individual organ, is formed independently of any other; that the body consists at first of a number of parts, each formed on its own type, as each possesses its peculiar irritability, and that they are united together only by the necessary connection of their separate functions, when these, as formation advances, are called into action. Take, for instance, a heart possessing but a single auricle and ventricle, while the rest of the body at birth presents a natural and healthy structure; this heart, though offering no impediment to formation during uterine life, is unable to perform its proper function after birth, and involves in disorder every part with which that function connects it,—in other words, the whole body,—and cyania is the result. It must not, however, be supposed that we maintain that a body can be formed without a vascular system of some kind; we only mean that it may vary in the form and number of its parts, without exercising a corresponding influence on any other part. Nor is the frequent occurrence of several malformations in the same body at the same time, any necessary proof of connection ; the same cause, (be that what it may,) which produced derangement of developement in one organ, acting more generally, may produce a similar effect in others.

We should not have dwelt at such length on this proposition, but for the important inference which necessarily follows, *that a monster should not be described or classified as one connected whole, but that the malformation of each organ or system of organs should be considered separately, while the state of the rest of the body is noticed only incidentally.* It is on this plan, therefore, that we intend to proceed ; and in spite of the great names opposed to us, we cannot but think that it is the only

one which, at least in the present state of the science, we are justified in adopting. *

We are obliged, then, to reject a strictly natural classification, and our reasons for doing so have been already given ; but as some arrangement is absolutely necessary, where so many objects are to be described, perhaps the one first proposed by Buffon is the best. It is equally applicable to any part as to the whole body, and has the singular merit of being unincumbered by hypothesis. It might be considered more philosophical to form an arrangement depending on the causes to which we attribute the error of formation, and this we should undoubtedly have preferred, were we not aware that scarcely any two authors would then agree, besides that it would probably require modifying, as often as any addition was made to our knowledge of the formation of the body. The arrangement we have adopted, classes monsters into those of defect,—those of excess,—and those of malposition. These we shall subdivide, as may be most convenient, under each particular head, without confining ourselves to any fixed principle, prefacing the description of each with an account, as far as we are able to determine it, of the mode in which we suppose it to be formed.

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* Since this paper was written, we have had an opportunity of seeing the April number for the present year, of the Archives Générales de Méd., containing an article by M. Breschet on the congenital malformations of arrestment of developement (or agénésie, as the author terms it,) of the brain. This article contains several facts, showing the independent formation of parts intimately connected, (as of the brain and skull,) and from its general tenor, we cannot help flattering ourselves that we shall have the concurrence of so high an authority as M. Breschet, in the opinion expressed above.

Part II.

Malformations of the Heart.

*Malformations * of Defect.*

There is perhaps no fact better established in physiology, than that every organ in the body, in the course of its developement, passes through a regular and determinate series of changes, becoming gradually more complex in structure in proportion as the animal approaches its perfect state. It is moreover equally certain that many of the organs of the higher classes of animals, at an early period of their existence, present appearances analogous to those observed in the lower: that they go throw similar changes: exceeding them only in complexity and multiplicity of parts, as the one excels the other in the ultimate perfection of its form.

This being determined, it requires no great stretch of imagination to conceive, that if the evolution of a part be impeded in any one of these changes, if the "*nisus formativus*" be at any time checked in its operation, we shall have a malformation exhibiting some of the characters proper to the period at which this has occurred. In some of these, we have presented forms natural only to the adult in lower classes of animals; in some, the persistence of parts adapted only to the fœtal state of existence; while in others, there is simply an absence or imperfection of some of the parts necessary to constitute the perfect organ. This theory of "retardment," or "arrestment of developement," which, without pretending to account for monstrosity, only attempts to point out the manner in which it sometimes takes place, was first prosecuted, if not first pro-

* For those unaccustomed to the study of these subjects, it may be necessary to define what we mean by the term *malformation*. The fœtus during gestation is subject to two distinct species of organic derangement; the one having relation to *dimension and structure*, the other only to the *form*, *number*, *and connection* of its parts. The former is congenital disease, the latter congenital malformation. The heart of the fœtus may undergo hypertrophy or ramollissement; it is then diseased; it may have the *foramen ovale* open, it may be double, or it may be placed in the abdomen; it is then said to be malformed.

posed, * by Meckel, and has been since more fully illustrated by Sœmmering, Tiedemann, and Mayer, by St Hilaire, Serres, Beclard, Breschet, Chaussier, Adelon, Andral fils, and many others in France. Almost all the malformations of defect † are referable to this principle, and those of the heart in particular afford striking illustrations of it.

To understand the application of this principle to the examples we shall bring forward, some previous knowledge of the developement of the vascular system is absolutely necessary ; and as it is a subject to which, in this country, comparatively little attention has been directed, we shall subjoin a short analysis of its history. In doing this, we shall confine ourselves to the formation of the heart and great vessels in the vertebrated animals ; for though we are inclined to admit that the invertebrate observe the same general laws, yet their structure presents so many apparent anomalies, and their fœtal organization is so little understood, that we can scarcely trace in them the same common laws of formation.

The simplest state in which the vascular system exists is, according to M. Serres, ‡ double. Like the nervous system and other parts of the body, it is formed from the circumference to the centre, § and becomes united by what has been called the law of conjunction. Thus the aorta is at first composed of two separate vessels lying on each side and below the spinal marrow, which are continued from the umbilical or omphalo-mesenteric arteries. These approximating first in the dorsal region, gradually unite as they descend, and at last form one continuous trunk. In the upper part of the body, the arrangement is more

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* In the Dictionaire de Médecine, article " Monstruosité," the credit of having first suggested the idea is given to Littre in 1700 ; as, however, nothing was then known of progressive developement, it could have been only a suggestion ; and the merit of having first applied it, must be yielded to Meckel.

† Some of those of excess and malposition acknowledge a similar cause. We shall speak of them hereafter.

‡ Anatomie Transcendante, par M. Serres, Annales des Sciences Nat. T. xxi. (1830.)

§ Some of the German anatomists strenuously deny this theory of formation. Baer gives as one of the conclusions at the end of his epistle on the formation of the egg, &c. that " all evolution proceeds from the centre to the periphery. It follows, therefore, that the central parts are formed before those of the circumference." Rép. Gén. d'Anat. Tom. vii. p. 189.

complex. * At a very early period the bulb of the aorta, as the vessel continuous with the heart is then named, divides into five pairs of vessels, which pass back to certain fissures in the sides of the œsophagus, called branchial clefts, as the vessels passing to them are called branchial arteries, from the close analogy they bear to the structure of the adult fish, or the young of the *Batrachiæ*. Each of these vessels opens posteriorly, into the two vessels we have mentioned as lying along the spine, and which never unite higher than the middle of the dorsal region. The upper ones of these branchial arteries, undergo nearly the same changes as the vessels of the tadpole when its *branchiæ* become obliterated; and the vascular system of this animal bears a very close analogy to that of the fœtus of mammalia, at this early period. The first pair of vascular arches become the carotids; the second and third are said to unite to form the subclavians; the fourth constitute the aortæ, (permanently double in reptiles as far as the middle of the dorsal region;) while the fifth form the pulmonary arteries. In birds the arch of the aorta is single, and is formed by the fourth vessel on the right side; in mammalia, on the contrary, the fourth on the left side constitutes the aortic arch.

The *ductus arteriosus*, or *ductus Botalli* of continental authors, is formed by the persistence of the communication between the fifth arch or pulmonary artery and the systemic aorta. In the turtle and many other reptiles, this communication remains open on both sides through life; in birds it has been clearly seen on the right side; and in mammalia there can be little doubt that it is formed on the left in a similar manner. On this point, however, there has been some difference of opinion. Meckel,† and in this he has been followed by Dr Allen Thomson,‡ supposes it to be formed by the division of the bulb of the aorta into the pulmonary artery and aorta proper, when a small channel of

* Dr A. Thomson on the Developement of the vascular system in the fœtus of Vertebrated Animals, part 2d. Edin. New Phil. Journal, January 1831; and the translations of the writings of Baer and Rathké on Fœtal Developement in the Répertoire Générale d'Anatomie, &c. Tomes vi. vii. and viii.

† Mémoire sur l'Histoire du Développement du Cœur, &c. Journal Compl. Tome i. p. 259.

‡ Edinb. New Phil. Journal, Jan. 1831, p. 75.

communication is left in the upper part, which gradually elongates to form a vessel. Some curious malformations of the aorta first led me to question this opinion, and my doubts were strengthened by considering the function attributed to the *ductus arteriosus* by Kilian; * that of carrying on the whole circulation during fœtal life to the lower part of the body, by means of its direct communication with the *aorta descendens.* †

The same law, as to original duplicity, is observed in the formation of the great single veins. The *vena cava*, superior and inferior, are at first both double; and, as with the arteries, we find this structure permanent in certain animals. In the elephant there are two *venæ cavæ superiores.* The same structure is observed in many birds, and in some the inferior cava is also double. In the *Sauria* both these appearances are constant. Kilian, ‡ (who wrote before the publication of M. Serres' discovery,) in speaking of the *vena cava inferior*, describes it as a single vessel ending in two very short branches, opening separately one into the right, the other into the left auricle; the *foramen ovale*, which is the orifice of the left branch, thus forming, only secondarily, a communication between the two auricles. The discovery of Serres, § which we shall sum up in his own words, tends to confirm the opinion advanced by Kilian: "En définitive, tout artère médiane et unique est primitivement double: cette dualité artérielle tend à l'unité en marchant de dehors en dedans, et arrive à ce terme par une série de transformations que j'ai comprises sous les trois régles dites *loi de formation de la circonférence au centre, loi de symétrie, et loi de conjugaison.*"

Thus, in the formation of vessels, multiplicity leads to unity. In the heart, on the contrary, unity leads to multiplicity; for

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* Ueber den Kreislauf des Blutes im Kinde welches noch nicht geathmet hat. Karlsruhe, 1826, and Arch. Gén. de Méd. T. xvi.

† We have been glad to find that Dr Allen Thomson has since confirmed this opinion, and corrected the error, in a note to the last part of his valuable paper. He has been able to trace the communication in the early fœtus of several mammalia. We cannot neglect this opportunity of returning our thanks to Dr A. Thomson for the kind assistance we have received from him, in the course of our inquiries on this subject.

‡ Arch. Gén. de Méd. T. xvi p. 564.

§ Annales des Sciences Naturelles, T. xxi. p. 20.

in each of its changes it progressively increases in the number and complexity of its parts.

The simplest state in which the heart has been described in vertebrate animals is by Rathké * in the fish, when he says it is first observed as a small reniform body, speedily becoming a sac, pointed at both ends, and soon forming a simple enlarged tube, continuous with the great vascular trunks. This tube next assumes a slightly convoluted figure, and dividing into two parts, forms the single auricle and ventricle natural to the adult heart in this class of animals.

In mammalia the heart has never been seen in the state of a simple sac or straight tube, though we can have but little doubt that it does pass through these primary forms, since it has been seen in this state both in reptiles and birds, and since in every other respect, the heart of mammalia obeys the same laws of formation as that of other animals.

The earliest period at which it has been observed is by Baer † in the dog at the twenty-first day, when it consists of a membranous tube, twisted on itself, and slightly divided by a notch on its surface into two cavities, an auricle, receiving the two *venæ cavæ*, and a ventricle, giving off the bulb of the aorta; a form nearly analogous to that of the fish at term, or of the chick about the sixtieth hour. The next change is the formation of the septum of the ventricles, which commences at the anterior and upper side of the common cavity, and is last formed at the openings of the auricles, at the bulb of the aorta, and at the posterior part; where Meckel says they communicate in the human embryo till the eighth week. Synchronous with the separation of the ventricles, a notch is observed to form on their outer surface, rendering the apex bifid; and in this state it is said by the same author, to continue to the tenth week. About the same time, the division of the bulb of the aorta commences at the lower part and proceeds upwards, forming two vessels, the root of the pulmonary artery, and ascending portion of the systemic aorta. The inter-auricular septum is somewhat later

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* Dr A. Thomson, Ed. New Phil. Journal for Oct. 1830, p. 16.

† De Ovi Mammalium et Hominis Genesi Epist. &c. a Baer, 1827. p. 3. And Rép. Gén. d'Anat. &c. p. 160, Tome vii.

in its appearance; and, of course, is not perfect till after birth, when the valve of the *foramen ovale* is fully formed.

Of the formation of the pulmonary veins, nothing appears to have been observed.

At what period the pericardium shows itself, or how it is formed we have been unable to learn. Rathké * observed it in the embryo of the pig at three weeks; and Baer † in the case already quoted says, "In nostro fœtu præter cuticulam pectus tegentem jam tenerrimum pericardium adest, quod ante atrium et ventriculum distinguitur." Rathké ‡ describes it also as present in the chick on the third day. It is developed, therefore, at a very early period, and is probably formed by a fold of the common serous layer of the germinal membrane.

There are some circumstances in the locality of the heart, which require notice. At the earliest period, the heart as well as the rudiments of the abdominal viscera are uncovered, the parietes of the thorax and abdomen being yet unformed. During the progress of developement, the heart seems to undergo certain changes in situation, and the embyro itself makes a movement to one side. § This has been chiefly observed in birds, but seems to be little understood. The heart in the early human fœtus is said by Meckel || to be placed symmetrically in the thorax, and to retain that situation till the ninth week, when he first observed it to incline to the left side.

To enter further into the history of the developement of the vascular system, would lead us too far away from our subject. We must content ourselves, therefore, with referring those curious in the inquiry, to the works of Meckel, Pander, Baer, Rathké, Serres, Kilian, and Allen Thomson, while we proceed with the consideration of the malformations of defect.

Acardia, or total absence of the heart, is a case of comparatively rare occurrence, and is generally found only in conjunction with absence of the brain or the upper half of the body.

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* Mémoire sur le Développement des Organes de la Respiration, &c. Par le Professeur Rathké, Répértoire Gén. d'Anat. Tome vii. p. 32.

† Op. et loc. cit. et Rép. Gén. Tome vii. p. 160.

‡ Rép. Gén. Tome vii. p. 16.

§ Edinb. New Phil. Journal, Oct. 1830, p. 22; and Histoire du Développement des Animaux, par Baer, Répert. Gén. d'Anat. T. viii. p. 93.

|| Journal Complém. Tome i. p. 269.

Examples of this kind have been recorded by Hunter. * Winslow, † Mery, ‡ Le Cat, § Meckel, || Lawrence, ¶ Tiedemann, ** and Elben, †† not to mention a number of older authors, whose testimony might be thought less worthy of credit. It may be observed, that in almost all these cases there were twins, one of which was in general naturally formed. In these monsters many other parts besides the brain and heart are often defective, especially the liver and stomach. There are, however, at least two cases, the authenticity of which cannot be doubted, where the nervous system was found quite natural; the one was seen by Marrigues ‡‡ in 1757, and the other by Brodie §§ in 1809. In the former, the chest was filled with watery fluid; the lungs, liver, stomach, spleen, kidneys, and genito-urinary organs were wanting. They were not able to trace any vascular system. In the latter, there was likewise a cyst filled with water distending the skin at the posterior part of the neck and thorax, and some of the organs were also deficient; but it is the arrangement of the vessels, which has been accurately described, that particularly deserves notice. The umbilical chord consisted of one artery and vein. "The artery passed to the left groin by the side of the urachus, occupying the usual situation of the left umbilical artery. Here it gave off the external and internal iliac arteries of the left side, and was then continued upwards on the fore part of the spine, forming the aorta. From the aorta rose the common trunk of the right iliac artery, and the branches to the viscera and parietes of the thorax and abdomen. At the upper part of the thorax

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* Dr Hunter's Anatomical Museum contains two cases.

† Hist. de l'Acad. Royale des Sciences, 1740.

‡ Ibid. 1720.

§ Phil. Trans. for 1767.

|| Handbuch der Pathologischen Anatomie, Band i. p. 414.

¶ Med. Chirurg. Trans. Vol. v. p. 168.

** Anat. der Kopflosen Missgeburten, 1813.

†† De Acephalis sive Monstris Corde carentibus Dissertatio, &c. Berolini, 1821. The two cases we are about to quote sufficiently disprove the connexion which the title of this work declares that the author must have supposed absolute.

‡‡ Mem. de Mathem. presentés à l'Acad. Royale des Sciences, T. iv. p. 123, and 129. Daniel, Col. Op. Med. Leipsig, 1776, p. 276, and Rép. Gén. d'Anat. &c. T. ii. p. 3, note.

§§ Phil. Trans. for 1809, p. 161.

it sent off the two subclavian, and afterwards divided into the two carotid arteries, without forming an arch. The veins corresponding to these arteries terminated in the *vena cava*, which was situated on the anterior part of the spine, before the aorta, and passed downwards before the right kidney to the left groin. Here it became reflected upwards by the side of the urachus to the navel, and was continued into the larger vessel or vein of the cord." There was here no communication between the arteries and veins, except in the capillary vessels, and in the placenta. Is it not possible to trace some analogy between this arrangement, and that observed in some of the invertebrate animals?

The nearest approach to this in simplicity of form, is a malformation described by Wilson.* It was found in a child of seven days old, whose functions seem to have been comparatively little disturbed. The heart, imbedded in the substance of the liver and protruding like a tumour from the abdomen, with only a thin membranous covering to protect it, was found to consist of but one ventricle and one auricle; from the former of which arose the aorta, giving off in its course one branch to form the *aorta descendens*, and another to supply the place of the pulmonary artery. The blood was returned from the lungs by two veins joining the *vena cava superior*, and opening into the auricle with it. The form of this heart is nearly allied to the perfect structure of the organ in fishes,—the distribution of its vessels similar to that of the *Batrachia*,—while in locality, this heart bears a close analogy to that of the *Chelonia*, and some of the *Sauria*.† A case strongly resembling this is recorded by Mr Standert,‡ and another by Dr Farre.§ In the former it is said, "the aorta sent off an artery from the situation of the *ductus arteriosus*, which divided into two branches, supplying each mass of the lungs;" while in the latter, there were two pulmonary arteries, the first branches given off by the aorta. Another example of this structure is afforded by the heteradelphe monster described by Professor Mayer,‖ which has already

* Phil. Trans. for 1798, p. 346.

† Cuvier, Leçons d'Anatomie Comparée, T. iv. p. 217 to 226.

‡ Phil. Trans. for 1805, p. 228.

§ Essay on the Malformations of the Human Heart, 1814, p. 2.

‖ Graefe und Walther's Journ. T. x, cah. 3. Arch. Gén. de Méd. T. xvii. p. 578.

furnished us such powerful arguments against the hypotheses of Tiedemann and Serres, and in favour of independent formation. Dr Ramsbotham has recently added another to this already ample list. *

Advancing a step further in developement, we sometimes meet with a single ventricle furnished with two auricles, occasionally only imperfectly divided. An instance of this was seen by Wolf, † a second by Farre, ‡ and two others by Breschet. § In the first of these, the subject had attained the age of twenty-two years. In the second, the aorta and pulmonary artery were both present, but arose "side by side" from the common cavity. This arrangement is, in many respects, similar to that which prevails in certain of the *Chelonia*. One of the cases described by Breschet, might almost be considered as belonging to the same class as that recorded by Wilson, as there were no traces of an auricular septum; but it was distinguished, by possessing an auricular appendage on each side, showing the rudiments of a heart formed on the double type of mammalia, while, in the former, the single structure of the fish was observed.

Imperfection in the septum of the ventricles is the next malformation, reckoning in the order, in which the parts are formed. This is a case of pretty frequent occurrence, instances of it being mentioned by Corvisart, Baillie, Meckel, and Louis, and our medical periodicals daily recording examples of a similar kind. The opening is generally found to occur in one of three situations;—between the origins of the aorta and pulmonary artery,—under the mitral valve,—or at the base of the heart; the parts which we have previously described as last formed, and which are therefore, according to a well known law in anormal formation, most subject to arrestment of developement. This again is a structure, the repetition of which is frequent in lower animals.

A near approach to this malformation is one noticed by Mr Spittal, to whom I am indebted for the communication of it.

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* London Medical and Phys. Journal, Vol. lxi. p. 548.

† Kreysig, die Krankheiten des Herzens, Band iii. p. 200.

‡ On Malformations of the Heart, p. 30.

§ Rép. Gén. d'Anat. &c. T. ii. p. 8 and 11.

This gentleman in two cases, remarked a failure of the muscular substance in the septum of the ventricles, for a small space between the roots of the great arteries; the ventricles being still without communication, since the transparent lining membrane of the cavities extended over the defective part, and preserved them separate and distinct.

It will be most convenient in this place, to notice the malformations of the aorta and pulmonary artery, as they are generally connected with similar affections of the ventricles, and often seem to depend on, or even to determine them. We have already noticed one case, * in which the aorta and pulmonary artery arose near each other; this structure is sometimes so marked, as to give the appearance of one common origin for both. This malformation is easily explained, by considering that at first, these vessels are only separated by the division of the bulb of the aorta, which process, in such cases, has not been perfected at the lower part.

The origin of the aorta † from both ventricles, has been pretty frequently observed, and generally in conjunction, with imperfection of the *septum ventriculorum*. ‡ The pulmonary artery in some of these cases rises as usual from the right ventricle, and preserves its healthy structure; but it is more common to find it attended by another alteration, first noticed by Dr Hunter, § a diminution of the size of the pulmonary artery. The cause of this, may be either simple contraction of its orifice, as in most of the instances on record; the union of the semilunar valves; || or the growth of a tumour within the vessel itself. Of the latter description, there is a preparation in Dr Macartney's splendid Museum of morbid anatomy, in the University of Dublin. The two latter of these deviations at least, depend on struc-

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* Farre, Op. Cit. p 30.

† Andral, in his Anatomie Pathologique (T. ii. p 376,) states that the aorta may rise from both ventricles, under three circumstances, 1*st*, When the interventricular septum is deficient; 2*dly*, When it deviates from its usual situation; and 3*dly*, When "il existe un canal accidentel qui fait communiquer médiatement le ventricule droit avec l'aorte." Andral has not quoted his authorities, and I do not know of any case in confirmation of this last means of communication.

‡ Observations on Diseases of the Heart, by A. Burns, p 13, Sandifort Obs. Anat. Pathol. &c. &c. &c.

§ Med. Observ. and Inquiries, Vol. vi.p 291.

|| Morgagni de sed. et caus. Morborum, Epist. xvii. Art. 12.

tural derangement; the union of the valves, perhaps on inflammation; the tumour, on morbid growth; and both are therefore congenital diseases, noticed here, only as frequent concomitants, and perhaps causes of the malformation. In most of these cases, another part of the fœtal structure is also preserved, the *ductus arteriosus* remaining open, and thus allowing an additional small quantity of blood to enter the pulmonary circulation by a retrograde movement.

The *ductus arteriosus* is subject to some important organic deviations. The one just mentioned is frequently met with, both alone, and in conjunction with other malformations. In a case related and figured by Tiedemann, * the open duct is seen entering the *aorta descendens*, at some distance below the situation at which the left subclavian artery is given off. In another case, † it was observed opening into the left subclavian; a case in itself sufficient to disprove the opinion advanced by Meckel as to its origin, but easily explicable, when we consider it as a remnant of the fifth branchial arch.

In a case which lately occurred in St George's Hospital, London, ‡ instead of a *ductus arteriosus*, a direct opening is said to have existed between the pulmonary artery, and arch of the aorta, just beyond the origin of the left subclavian artery. "The *ductus arteriosus* in the natural situation was deficient." The patient died at the age of twenty, with all the symptoms of disease of the heart, some of which appear to have been congenital. This is the only malformation, which in any degree, appears to support the opinion of Meckel just alluded to; but though we have quoted it as we find it recorded, we are much inclined to doubt the reporter's interpretation of it. We should rather consider it, as simply a shortening of the arterial duct, especially as no remains of it were to be observed in any other situation. Farre § saw a case approaching to this in the Museum of Mr Langstaff, where the *ductus arteriosus*, though pervious, was remarkably short and small.

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* Zeitschrift für Physiologie, b. i. p 111, Tab. vii. Fig. 9.

† Arch. Gén. de Méd. T. iii. p 340.

‡ Johnson's Medico-Chirurgical Review, for Dec. 1830. No. xxvii. p. 231.

§ Farre, Op. Cit. p. 19.

Howship* has related a case, where the *ductus arteriosus* remained open, and constituted the trunk of the pulmonary artery. The pulmonary artery proper, took its origin in its usual situation, but was quite impervious at its root, though free beyond, and terminated in a *cul-de-sac* beside the heart. Farre † describes and figures an example of a nearly similar nature, having the pulmonary artery impervious as far as its bifurcation, and its place, as before, supplied by the arterial duct. The *ductus arteriosus* must have performed a similar office, in a preparation preserved in the Museum of the Edinburgh College of Surgeons, where the pulmonary artery is in like manner obliterated, and both ventricles communicate under the origin of the aorta. In the same museum is another case, in many respects similar to the last; but that the pulmonary artery was only contracted, not closed, and the *ductus arteriosus*, therefore, less patent than in the former. In these cases, then, the *ductus arteriosus* has supplied the place of the defective pulmonary artery; in those we are about to relate, it performs the office of the *aorta descendens*, as in the fœtus.

Sir A. Cooper, ‡ met with two instances, in which the aorta, after giving off the three great vessels to the head and upper extremities, terminated in a very small branch joining the *aorta descendens;* this latter vessel, was formed by a branch of the pulmonary artery, following the course natural to the *ductus arteriosus*. In both cases, the root of the pulmonary artery communicated with each ventricle.

A still more perfect example, of a nearly similar kind, has been published by Steidele. § Here, however, the aorta and pulmonary artery rose as usual. The aorta was entirely distributed to the head and upper extremities, while the pulmonary artery, after giving off two branches to the lungs, continued as the *aorta descendens*, without any communication with the *aorta ascendens*. It is almost unnecessary to remark, how strongly this supports Kilian's opinion respecting the function

* Edin. Med. and Surg. Journal, Vol. ix. p. 399, and another by Breschet in the Rép. Gén. d'Anat. T. iii. p. 8.

† Farre, Op. Cit. p. 27, Fig. 13.

‡ Farre, Op. Cit. p. 14, Fig. 5 to 10.

§ Sammlung Chirurgischer Beobachtungen, b. ii. p. 114.

of the pulmonary artery during fœtation, (viz. that of carrying on through the *ductus arteriosus* the whole circulation to the lower extremities,) as well as our suggestion, as to the origin of this vessel.

We now come to the malformations of the auricles, and the parts immediately connected with them.

The existence of only one auricle when the ventricles were double, has been noticed by Haller, * and similar cases have been more recently seen by Ring † and others. It is curious, that in the case dissected by Haller, as well as in one which lately occurred in France, ‡ the subject of this malformation was a heteradelphe monster, united only by the epigastria, and in whom almost all the other organs were double. In Ring's case, the *vena cava inferior* opened into the left part of the common auricle, while each side possessed a *cava superior*.

Communications take place between the auricles, in two different ways,—by imperfection of the septum, properly so called, or by the persistence of the *foramen ovale*. An instance of the first kind, has been observed by Lawrence and Farre, § in which the septum, consisting only of a muscular band, crossed from one auricle to the other. Another case is recorded by Walter, ‖ where there were two foramina in the septum, one formed by the *foramen ovale*, the other by a true imperfection of a part of its walls. In the extensive Museum of the College of Surgeons of Edinburgh, another specimen is preserved, showing two foramina in the auricular septum.

The open state of the *foramen ovale* is one of the malformations first noticed, and one on which the older physiologists used to amuse and confuse themselves, with a thousand idle theories, now almost forgotten. This, and the open *ductus arteriosus*, may be cited as the best examples, of the persistence of parts adapted only to fœtal existence. It may arise, either from absence of the valve, from non-union of the sides of the valve, or from perforation of the valve by several small foramina, ¶ and is

* Haller de Monstris, lib. i. cap. 29.

† Med. and Phys. Journal, Vol. xiii. p. 120.

‡ Arch. Gén. de Méd. T. xxii. p. 259.

§ Farre, Op. Cit. p. 30.

‖ Walter, Observ. Anat. folio, p. 8.

¶ Catalogue of the Preparations in the Anat. Museum of Guy's Hospital, by Dr Hodgkin. 1829. No. 1386.

so common in one or other of these forms, that every morbid anatomist must have met with it. In extent, it admits of great variety; Corvisart* mentions a dissection, in which he found the foramen more than an inch in diameter, while in others, it is scarcely a line.

A still more complicated malformation, is produced by the imperfection of the septa at the point of general union, in which case all the cavities communicate freely with each other. Such an occurrence is recorded by M. Thibert. † The patient lived to the age of twenty-four years.

The valves, also, of the heart and its great vessels may be defective, either partially or totally. This most frequently happens in the sigmoid valves of the pulmonary artery, especially in conjunction with contraction of its orifice. Andral ‡ states, that the aorta is occasionally furnished with only two valves; and I have been lately shown a case of the kind by Mr Spittal. § Mayo || has placed another on record. In the mitral and tricuspid valves the same deficiency sometimes occurs, several instances of which have fallen under my own observation. Meckel ¶ refers likewise to some cases of absence or defect in the Eustachian valve, probably not an uncommon occurrence. All the valves, like that of the *foramen ovale*, are frequently pierced with a number of small foramina. As little notice has been directed to the formation of the valves, it is difficult to trace all their malformations to arrestment of developement; but in the preparation preserved by Mr Spittal, two of the sacs appeared continued into one, from the failure of the part by which the free edge of the valve is usually bound down to the side of the aorta.

In external form, the heart is rarely much changed, except as the effect of chronic disease. It does, however, sometimes preserve its fœtal character in this respect. The most common of these deviations, is the persistence of the shape observed at the seventh month, when the two ventricles are of an equal size and thickness, and the apex is rounded or flat. I think I have seen

* Corvisart, Traité sur les Maladies de Coeur, ed. 2d, Paris. p. 284.

† Bulletin de la Faculté de Méd. année 1819.

‡ Andral, Anat. Patholog. T. ii. p. 377.

§ A Treatise on Auscultation, by R. Spittal. Edin. 1830.

|| Mayo's Elements of Physiology.

¶ Meckel, Dissert. Inaug. de Cordis Conditionibus Abnorm. p. 29.

this structure, in more instances than one, when quite unconnected with organic disease. An extraordinary case is recorded by Bartholinus, * in which the heart is said to have been bifid at the apex, " Mucrone non acuto, ut fieri solet, sed bifido," thus presenting us the appearance, which has been already noticed as prevailing in the fœtus till the tenth week. We are inclined to consider, as similar to this, a case quoted by Ignatius de Torres † from Amorosius, though it is scarcely related with the minuteness we could wish. He is said to have observed " a heart with two points, which on the outside showed the two ventricles." These cases are rendered the more interesting by the circumstance, that the bifid apex, is a form natural to the heart of some of the mammalia. The heart of the Dugong, a specimen of which I had lately an opportunity of examining in Dr Knox's museum, affords a fine example of it. The repetition of this structure in mammalia, together with the late period to which it continues in the human fœtus, would lead us to expect the occurrence of this malformation much more frequently, but we know of no other cases on record.

Absence of the pericardium, cases of which have been frequently mentioned by the older writers, was, by the more modern sceptics in philosophy, considered never to occur, except when connected with malposition of the heart, till its possibility was fully established by Breschet. ‡ The case related by this author, evidently depended on arrestment of developement, for rudiments of the pericardium, in the form of several folds and fibrous bands, were present, and marked the commencement of its formation. The heart was covered by a continuous layer of the pleura, and it is probably only a reflection of this membrane,

* From the rarity of this case, and the uncertainty always attached to cases of monstrosity recorded by the older anatomists, I subjoin the whole history in the words of Bartholinus.—Cor Bifidum.—Christophorus Giòe, vir nobilissimus, provecta ætata rerum rariorum erat amantissimus, et secretis medecinæ apprimé deditus. Inter alia singularia quæ humanissimis suis colloquiis nonnunquam interspergebat narravit mihi, in Norwegia pridem a se visum latronem qui pœnas scelerum luebat. Quum extenteraretur a carnifice, cor habuisse singularis figuræ, mucrone non acuto, ut fieri solet, sed bifido ut distincti ventriculi manifestius externa facie apparuerint dexter nempe et sinister, interjecto hiatu.—Thomæ Bartholini, Historiarum Anatomicarum Centuria i. et ii. Hafniæ, 1654, 8vo. Cent. i. Hist. 67, p. 117.

† Phil. Trans. abr. Vol. viii. p. 508.

‡ Répért Gén. d'Anat. &c. T. i. p. 67.

subsequently thickened, in which it was deficient. Undoubtedly many of the cases formerly recorded, as of defective pericardium, were only adhesions between this membrane and the heart, the effect of pericarditis. From the early formation of the pericardium, it is not probable that this malformation frequently occurs. Haller says that none of the inferior animals which possess a heart, want the pericardium. *

Malformations of Excess.

The mode of formation of monsters of excess, is a question which is still concealed in the greatest obscurity. The absurdities which our older writers were guilty of, the freedom in which they indulged their fancy on this subject, can scarcely surpass in wildness, the theories by which some of our more recent philosophers have thought to illustrate the question. This, however, must be attributed in a great measure, to the very nature of the subject itself. When such men as Meckel, Burdach, St Hilaire, Mayer, and Breschet, have all failed in their attempts to penetrate the darkness that hangs around it, the task must be confessed one of no ordinary difficulty. The causes on which such malformations depend, must, we fear, remain unknown, till chance shall throw in the way of some skilful anatomist a monster of excess in the very earliest stage of its formation; many doubtful points might then be cleared up, and more certain data established for the foundation of our future reasonings.

The most prevalent opinion as to their mode of formation, is that which attributes them to the attachment and union of two fœtuses, at a very early period of uterine life. As far as regards monsters of inclusion, where one fœtus is enclosed within the abdomen, or contained in a bag dependant from the perineum of another, we are inclined to think this principle may be true; but how it can act in producing an additional finger, a supernu-

* In the MS. catalogue of the Hunterian Museum of Glasgow, (M. *m.* No. 19.) a preparation is described as wanting the anterior parts of the abdominal parietes, and consequently exhibiting a hernia of the viscera, in which the apex of the heart is said to be attached to the anterior edge of the diaphragm. This probably refers to a case similar in some respects, to the one just quoted from Breschet. I was anxious to assure myself of this fact by personal examination, but have been unable to accomplish it, either because the preparation is lost, or, as is more likely, concealed by the very defective manner in which this fine museum is arranged.

merary heart, or double lower extremities, we confess we cannot see. It will be at once urged, that these cases depend on totally different causes; that the additional finger owes its origin to an increase of the nutritive energy merely; the double extremities only, to the approximation of two embryos, which, say they, by the pressure exerted on each other, have produced, as it were, a fusion of the two bodies, so that the upper extremities of only one are developed, though the lower ones of both are formed. Plausible as this may appear at first sight, a great difficulty presents itself on a moment's consideration,—where is the principle of increased nutritive action to cease,—where that of double generation to commence? for the series of gradual increase in the number and importance of additional parts, from the supernumerary auricle or ventricle to the double body of the Siamese twins, is continued in an almost unbroken chain. If we begin at the additional finger or toe, we may progressively ascend to the third eye, * the double upper and lower jaw, † the two hearts,‡ the organs of generation proper to both sexes in one body,§ the additional, though imperfect, lower extremities, ‖ the two heads and necks with the body single, ¶ the whole upper half of the body double,** two bodies attached by their bellies and chests, †† two others adherent by the pelvis, in which

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* Cat. of Anat. Mus. of Univ. of Edin. p. 245. "Chicken with one cranium, three eyes, and two bills. 2. G. 18."

† Op. et Loc. Cit. "Kitten with one head, and two upper and under jaws. Rest of body natural." 2 G. 13.

‡ Meckel, Dissert. Inaug. de Cordis, &c. p. 8. In the goose.

§ Cat. of Anat. Mus. of Guy's Hospital, by Dr Hodgkin. Observations to Section XI. of Part II. "The nearest approach to a true hermaphrodite with which the author is acquainted, occurred in an ourang outang, dissected, described, and delineated by Doctors Harlan, Morton, and Bird, of Philadelphia. It is stated to have possessed ovaries, Fallopian tubes, a uterus, and vagina; and also testes, epididymes, vasa-deferentia, and a highly-erectile penis."

‖ Annales des Sciences Nat. T. xxi. p. 333. Mémoire sur un enfant quadrupède, né et vivant à Paris, monstruosité determinée sous le nom générique *d'Ilea-delphe;* par M. Geoffroy Saint-Hilaire.

¶ Cat. of Anat. Mus. of Guy's Hospital. "A fœtus at or near the full period, with two heads and necks." No. 2548.

** Annales des Sciences Nat. T. xix. p. 153. Sur la fille Bicéphale Rita-Christina, par M. le Docteur Martin de Saint-Ange.

†† Cat. of Anat. Museum of Guy's Hospital. "Two male fœtuses, apparently at or near the full period; they are united by a considerable portion of their bellies and chests, and have a common umbilical cord." No. 2547.

the anus was the only part common to both,* till at last we reach the Siamese twins, in which the junction of two perfect bodies was formed only by a cartilaginous band. To give credence to a theory which presents so many anomalies is impossible; and to propose a new one, would be to incur almost the certainty of a failure. We may, however, venture to suggest, that by following up the doctrine of the independent formation of parts, as laid down in the former part of this essay, some of the difficulties of this subject may be removed. Let it be granted, that every organ or part is formed on its own type independently of every other part, and then suppose, that this may be double with respect to a system of organs, a single organ, or even one of its parts, and we shall find many of the phenomena of malformations of excess comparatively easy of explanation. On this view of the question, it is no longer necessary to consider an additional valve the only remaining part of a second heart, any more than to suppose, that three posterior extremities where the head is single, must necessarily have belonged to three individual fœtuses. It has been already shown, that the body may be formed when a heart or brain is wanting. What is there then more extraordinary, in the formation of a second heart or brain when the body is only single? To say on what this tendency to original duplicity depends, we do not attempt; to generalize a certain number of determined facts, must content us for the present.

The varieties of malformation of excess exhibited by the heart, are by no means all referrible, to the same law of formation; for though they all present some excess in the number or form of its parts, it is almost the only character in which they agree. There are three causes, under which we think all these malformations may be included, and we shall accordingly arrange them into three classes, distinguished by the different mode of formation to which we believe each attributable. The first depends on arrestment of developement, and includes all cases of increase in the number of the great vascular trunks; the second on con-

* See Dict. des Sciences Med. Art. Monstruosité, in which Buffon's celebrated monster Helen and Judith is described. This, or these girls, (for we know not in which number to speak) lived to the age of twenty-one. They were found to possess a very intimate vascular connection, by means of the aortæ and venæ cavæ at their bifurcation.

genital hypertrophy, exhibiting itself in additional parts not natural to the organ; and the third, on the tendency to double formation, which may manifest itself in the duplicity of the whole organ or some of its parts only.

Arrestment of Developement.—We have already spoken at some length on the principle of arrestment of developement, on which our first division depends. As with the malformations of defect, these also show strong evidence of the existence of this beautiful law; for we find the vessels, which in their natural state form the great azygos trunks, still presenting either partially, or through their whole extent, their primitive double state; while in others, we observe the permanence of some of the lower branchial arches, constituting varieties in the arch of the aorta and *ductus arteriosus.**

Of the first of these cases, the *venæ cavæ* afford some of the best illustrations. The *cava superior* has been found double by Ring †, Meckel ‡, Bœhmer §, Murray ‖, Breschet ¶, and many others; indeed, it may be reckoned among the malformations of most frequent occurrence. In the *vena cava inferior*, Kerkring ** describes a deviation, in which the vein was bifid as high as the liver, where it united, but again divided, and formed two trunks where it entered the heart. Another case of a double *vena cava inferior* is quoted by Meckel, †† in which the accessory vein rose from the liver, and opened into the right ventricle. Breschet ‡‡ relates two cases, to which we shall have to allude again more particularly, where, in addition to two *cavæ superiores*, the *cava inferior* was also accompanied by a second vein proceeding from the liver to the left auricle. In one of these instances, there were two pulmonary veins; in the other, the *vena azygos* was double. It is worthy of remark, that

* Here, as well as in other parts of this essay, we include the malformations of the great vessels in immediate connection with the heart, as it is impossible to omit the one without rendering the description of the other incomplete.

† Med. and Phys. Journal, Vol. xiii. p. 120.

‡ Manuel d'Anat. Gen. et Pathol. &c. Tome ii. p. 526.

§ De Confluxu Triarum Venarum Cavarum. 1763.

‖ Neue Schwedische Abhandlungen, T. ii. p. 236.

¶ Rép. Gén. d'Anat. T. ii. p. 7 to 11, Pl. 1.

** Kerkringii Spicilegium Anatomicum, Amstel. Obs. xxix. Tab. xi.

†† Dissert. Inaug. de Cordis, &c. p. 19.

‡‡ Rép. Gén. d'Anat. &c. T. ii. p. 11.

the abdominal aorta, the basilar artery, and other single arterial trunks, are all occasionally found double; while in those vessels naturally symmetrical, as the carotids, phrenics, renals, and spermatics, there is a great disposition to unite into a single trunk.*

To understand the malformations of excess in the aorta, we must call to mind the state of that vessel in early fœtal life. It must be recollected that it never unites beyond the middle of the dorsal region, but presents at one period almost exactly the structure of this part in the turtle, (viz. an arch passing down on either side, with a *ductus arteriosus* opening into it from each pulmonary artery,) and that the principal change which it afterwards undergoes, is the obliteration of this arch on the right side. In the magnificent plates of the arteries by Tiedemann †, there is a case quoted from Malacarne ‡, which beautifully illustrates this formation. The aorta, immediately after leaving the left ventricle, divides into two branches, which passing upwards, each give off, as in the turtle, the vessels to the head and upper extremities on each side, when they again unite to form the *aorta descendens*. It is true that the relative position of the parts in this instance has suffered considerable change, but that is of little importance, in comparison with the striking analogies they present in other respects. It is probable that another of the cases represented by Tiedemann, § from Homellius, ‖ may be traced to the same cause. In this, "Aorta sub arcus initium divisa et ad finem ejusdem sursus unita conspicitur. Per hanc quasi insulam, transeunt trachea et œsophagus." The arrangement of the vessels, as represented by Dr Allen Thomson ¶ in the chick about the 12th day, bear a sufficiently strong resemblance to this malformation, to enable us to trace an analogy. Serres** also refers to a case, though he has not entered into any details concerning it, in which he says,

* Dr Green on the Varieties in the Arterial System of the Human Body, Dublin, 1830, p. 26.

† Tabulæ Arter. Corp. Human. Tab. iv. Fig. 7.

‡ Osservazioni in Chirurgia, Torino, 1784, P. 2, p. 119, Fig. 1, 2.

§ Tabulæ Arter. Corp. Human, Tab. iv. Fig. 6.

‖ Commercium Litter. Norimberg, 1737. Hebdomas, xxi. p. 161, Tab. ii. Fig. 1, 2.

¶ Edin. New Phil. Journal, Jan. 1831, Plate iii. Fig. 31.

** Annales des Sciences Nat. T. xxi. p. 20.

"There was a bifurcation of the aorta, which in its upper part, reproduced what we observe in the *Sauria*." A case, offering some resemblance to this structure, but very curiously complicated, has been more lately described by Dr Chichester* of Cheltenham; that of a monster with one head, one heart, one stomach, but with the rest of the body generally double. In this instance it was observed that, "from each ventricle sprung an aorta; of the two vessels, one turned to the right, the other to the left. The one which turned to the left went down in the natural direction; while that which turned to the right, crossed the right vertebral column, and passed down on the outer side of it. A transverse vessel, of somewhat smaller caliber, passed from the beginning of the turn of the arch on one side, to the same part on the other side, thus forming a communication between the two aortas."

A double state of the *ductus arteriosus* is of very rare occurrence,—indeed we know of no other case, than the one we are about to relate from Breschet.† It occurred in a child, whose heart was placed in the centre of the thorax, and whose vascular system presented several other deviations from the natural state. The left arterial duct was observed opening as usual into the *aorta descendens*, under the origin of the left subclavian artery; while on the right side, a somewhat longer though smaller vessel, was found to communicate between the right pulmonary artery and right subclavian, just at the bifurcation of the brachio-cephalic trunk. When we consider that it is the fifth arch on the right side which in mammalia is obliterated, that it is the fourth which constitutes the right pulmonary artery, while the third forms the brachio-cephalic trunk, and that, consequently, between these two latter, a direct communication‡ must and does exist in the early fœtus, we cannot but confess, that a more beautiful illustration of arrestment of developement, could not be desired.

Congenital Hypertrophy.—It may be thought that, by in-

* Loudon's Magazine of Nat. Hist. Vol. i. p. 135, an account of a monster of the sheep genus, by John Chichester, Esq. M. D.

† Rép. Gén. d'Anat. &c. T. ii. p. 10, Pl. 1, Fig. A.

‡ See a diagram of the Branchial Arches of Mammalia, and their transformations. Edin. New Phil. Journal, Jan. 1831, Pl. iii. Fig. 39.

cluding cases of hypertrophy under the term of malformation, we are acting at variance with our own definition; but in these cases it seems necessary, for they approach so nearly to true malformations, not only in the forms they represent, but even in the mode of their formation, that it becomes very difficult to draw the line of distinction. The malformations of this class chiefly exhibit themselves in additional septa or false cavities, formed by the hypertrophy of the *columneæ carneæ*, or other part naturally belonging to the heart. Now it should be remembered, that it is said * to be only from the *columneæ carneæ* that the true septum of the ventricles is formed, and, therefore, the increased developement of such parts, is no more to be considered the effect of diseased action, than is the double state of the brain or heart itself.

The *columneæ carneæ* are sometimes hypertrophied to a considerable extent. The union of several of them, so as to form one thick fleshy mass, is a very common appearance in the heart. In a case mentioned by Louis, † they were so much enlarged, and so much pressed together, that they appeared to form one continuous plane; and in this way, we have no doubt, are many of the false septa, forming partial cavities, to be explained. They may be distinguished when occurring in the auricles, from those depending on original duplicity of form, by the absence of additional auricular appendages; and in the ventricles, by the presence of the single mesial line, marking the division of the right and left sides. Thus, in the case of a heart with only a single auricle and ventricle, seen by Farre, ‡ "the auricle was divided from its appendix more distinctly than it is in the natural structure, by an intermediate septum;" thus forming two partial cavities, but with only one auricular appendage. This is well contrasted by another case, shown to the same author § by Lawrence, where the auricles might have been called single, as they formed only one cavity, crossed by a thin muscular band, had not the two appendices proved that it was on an arrestment of de-

* "From part of these netted fibres, some of which, in a more advanced state, no doubt, constitute the columneæ carneæ of the ventricle, the septum which divides the cavity springs." Edin. New Phil. Journal, Oct. 1830, p. 27.

† Arch. Gén. de Méd. T. iii. p. 334.

‡ Farre on Malformations of the Heart, p. 3.

§ Ibid. p. 30.

velopement of the septum only, that the malformation depended.

Into the anormal cavities, thus formed by the increased growth of natural parts, vessels may often open. Farre * refers to two instances, of what he calls a third ventricle, in one of which "two apertures in the right ventricle communicated with a very small third ventricle, from which the pulmonary artery, correctly formed, and of its natural size, arose."

Other cases, apparently of this nature, have been described by the older anatomists, but not with an accuracy on which we can place much dependence.

Original Duplicity.—This may prevail with respect to the whole heart, or may be confined to some of its parts only.

The double state of the whole heart, when some other parts of the body are double, is not rare. Walter † has described a case in the human subject, and Monro ‡ in the calf. An exception to this rule, however, occurs in monsters by partial inclusion, which are united by the sternum, as in the heteradelphe of Benais, § where the heart and brain are almost the only parts single. Meckel || says that "in the goose, in the double state of the whole body, or of the upper extremities only, an increased size of the heart is frequent; a double heart, less common; and this state, still more rare, when the body is simple." Boerhave ¶ found two imperfect hearts in a rat. In another case, ** there were two perfect hearts, an inch apart, in the common fowl. Collomb †† has described a case of a completely double heart in the human subject, where there was, if any thing, a defective developement of other parts. The most indubitable case, is one recorded by Meckel, ‡‡ which we relate in his own words. "In patris quoquo musæo corda anseris unius exstant duo normalia, sed de quibus fere nihil dici potest,

* Farre on Malformations of the Heart, p. 26 and 30.

† Walter, Observat. Anatom. p. 8.

‡ Catalogue of the Museum of the University of Edinburgh, p. 245.

§ Mémoires du Museum de l'Hist. Nat. T. xv. p. 385.

|| Handbuch der Pathologischen Anatomie, Band ii. p. 34.

¶ Boerhave Pathol. Betrachtung des Herzens. Abhandl. für practische Aerzte, Band ix.

** Meckel, Disert. Inaug. de Cordis, &c. p. 8.

†† Collomb, Œuvres Med. Chirurg. Lyons, 1798, p. 462.

‡‡ Meckel, Dissert. Inaug. de Cordis Conditionibus Abnormibus, p. 48.

nisi quod singula duplex habeant cavum, et ex singulis aorta emergat, et ligamentum inter utrumque intercedat valde obscurum, cum casu tantum in ansere jam cocto inter mensam fuerint inventa."

Duplicity of some part of the heart only, is an occurrence of great rarity. Andral * in his Anatomie Pathologique, says "I have seen a heart with three auricles, and another with four ventricles," but does not give any more detailed description of them. One instance is mentioned by Kerkring, † in which there was a double state of the right ventricle, with two pulmonary arteries; and a second by Chemineau ‡ showing three ventricles united together, the right receiving the *vena cava*, the left the pulmonary veins, while the middle one gave off the aorta and pulmonary artery. These are the very few cases of this kind of malformation we have been able to collect, and the last even of these is more than doubtful. It is probably only a case of two auricles with a single ventricle; for Chemineau does not mention the state of the former, besides that he compares it to the heart of the tortoise, to which it would then be nearly allied.

Malformations of Position.

As we advance with our subject the difficulties of explanation, if possible, increase,—so innumerable are the varieties we meet with,—so imperfect our knowledge of anormal developement. Before the division of malformations on which we are now entering can be treated with any great success, it is necessary that we should possess a more accurate knowledge than has yet been obtained, of the relative situations occupied by different organs during the different periods of fœtal life. It is well known, that almost every organ does undergo considerable changes in this respect;—the descent of the testis furnishes a familiar example; and it would appear, that, as with respect to form and number, in position also, the changes increase as the animal rises in the scale of creation. The movement of the spinal marrow, has been noticed by Tiedemann and Serres; and that of the heart, is not less worthy of accurate investigation. We know that the

* Andral's Pathol. Anat. translated by Townsend and West, Vol. ii. p. 333.

† Kerkringii Spicileg. Anat. Obs. 69, Tab. xxii.

‡ Mémoires de l'Acad. des Sciences, 1699, p. 42.

heart, soon after its first appearance, is placed high in the neck, till it gradually descends, and occupies the centre of the thorax, where it remains placed symmetrically till a somewhat late period. We are even at present able to trace many cases of malposition, to arrestment of developement; others probably owe their origin to displacement from defective formation in neighbouring organs; some may perhaps be connected with certain movements of the embryo itself; others may arise from unnatural adhesions between various parts; while we must confess, that there are still many, which appear to set at defiance all laws of formation,—all relation of parts,—all adaptation of means to an end. Such at least they appear to us at present; but I have too much confidence in the motto, "l'ordre est dans le désordre," to believe that nature can ever act so much at variance with herself, or that there is any apparent anomaly, which a further knowledge of developement will not fully explain.

Malformations of position form two pretty distinct classes,—those of simple *exposition*, and those of absolute *transposition*; the first, where the organ or any part of it has merely changed its position without occupying that of any other part,—as where the heart is without the thorax; the second, where the whole organ has taken a situation directly opposed to that which belongs to it, or where some of its parts have exchanged places with each other,—as when the pulmonary artery rises from the left, and the aorta from the right ventricle. In both these divisions, are many examples, on which we scarcely dare hazard a conjecture, as to the mode of formation.

Exposition.—Among the cases classed as those of simple exposition, we find considerable variety. The organ may be placed entirely without the body; it may be situated within the body, but out of its proper cavity; it is found in its proper cavity, but out of its usual place there; and, lastly, the various parts of the organ may assume an unnatural position with relation to each other.

The first kind, in which the heart is on the outside of the body, includes some of the most fatal as well as most frequent cases of exposition of this organ. It is generally connected, either with deficiency in the diaphragm and abdominal parietes, or with absence of some part of the walls of

the thorax. In the former case, we generally find the heart, liver, and stomach, and often the lungs, and all the abdominal viscera contained in a sac, sometimes covered only by peritoneum, * sometimes by an extension of the common integuments, † and sometimes occupying the sheath of the umbilical cord, ‡ forming a variety of umbilical hernia. In some of these cases, adhesions have been traced between the misplaced viscera or the sac containing them, and the surrounding membranes. In one described by Breschet, § the umbilical cord, which had become attached to the sides and top of the head, contained within its sheath the abdominal and some of the thoracic viscera. The heart, occupying the upper part of this mass, was attached by its apex to the palate, with which it had formed adhesions. In another monster, described by the same author from M. Bonfils of Nancy, the heart and other viscera had become adherent to the placenta, and were thus drawn away and prevented from occupying their proper cavities. St Hilaire || relates a somewhat similar case, in which there were also evident marks of adhesion, to which he of course imputes the malformation; and indeed does not hesitate to refer all others to a similar cause, though we suspect it would be difficult to prove the assumption. When these adhesions occur, it is certain they must be contracted, before the parietes of the thorax are fully formed. At what precise period this process takes place, we are not aware; but from the comparative frequency of the malformation, it is probably late before it is completed.

Exposition of the heart, from defect in the parietes of the thorax, is less common. A heart in this situation, is said to have been seen by Martinezius, ¶ "with its cone and base lying horizontal, and without a pericardium."—"As if," adds the commentator, "the heart, not bearing so close a confinement, burst through the breast, and having broken the sternum,

* Many examples of this kind may be seen in the Hunterian Museum Glasgow. See also Arch. Gén. de Méd. T. xxiii. p. 511, and Rép. Gén. d'Anat. T. ii. p. 20.

† Acta Helvetica, Vol. vii. p. 56, de Fœtu Monst., &c. Meckel Dissert. Inaug. p. 6.

‡ Rép. Gén. d'Anat. T. ii. p. 25.

§ Ibid. T. ii. p. 24, Tab. ii.

|| Arch. Gén. de Méd. T. xii. p. 632.

¶ Phil. Trans. abridged, Vol. viii. p. 506.

appeared on the outside." In the museum of the University of Edinburgh,* is another example in a fœtal calf, where the heart is seen projecting between the ribs. Some additional cases of protrusion of the heart from the thorax are mentioned by Breschet,† especially from defect of the lower part of the sternum. In many instances, the disposition to imperfect formation along the mesial line, on which such deficiencies depend, shows itself at the same time in other parts, as by the hare-lip, the defective palate, the *spina bifida*, the open perinæum, and many others. It may be difficult in these cases to say, whether the malposition of the heart may be the cause or the effect of the malformation of the sternum; or whether, as is equally probable, both may not arise from an extension of the same general cause, without any necessary dependence on each other.

The situations assumed by the heart, when within the body but out of the chest, have been found to vary, from the abdomen to the neck. In Mr Wilson's case,‡ which has been already referred to, the heart was in the abdomen, lodged in a fissure on the surface of the liver. Some of the tendinous part of the diaphragm was in this instance wanting, and the heart formed a tumour protruding from the upper part of the abdomen; so that, although this could not be considered actually out of the body, it was a very near approach to the former species. M. Deschamps§ has given the particulars of a much more perfect case, in which the heart was found to occupy the place of the left kidney. By no means the least curious circumstance in this history is, that the man had passed an active life, and attained a considerable age, without ever suspecting any displacement of the heart. There does not here appear to have been any malformation of the diaphragm, nor indeed of any other part. It is exceedingly difficult to account for this case of malposition, unless we suppose the heart to have been pushed down by some enlargement of the lungs or thymus gland, or

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* Cat. of Anat. Mus. of Univ. of Edin. p. 245.

† Rép. Gén. d'Anat. T. ii. p. 15.

‡ Phil. Trans. 1798, p. 346.

§ Journal Gén. de Méd. &c. T. xxvi. p. 275. Rép. Gén. d'Anat. T. ii. p. 17.

bound down to the abdominal viscera by adhesions, contracted before the diaphragm was formed.

In the excellent memoir by M. Breschet before referred to, "Sur l'ectopie du Cœur," a case * is described, in which the heart, lungs, and thymus gland were all contained in the anterior part of the neck, forming a large tumour under the lower jaw. The point of the heart, attached to the base of the tongue, was placed between the two branches of the lower jaw, which were very small, and separated from each other. The thorax was occupied by the abdominal viscera, which had passed up through a fissure in the diaphragm. Breschet conjectures that this is a case of simple arrestment of developement, since the heart occupies a nearly similar position in the early fœtus. Though we allow that, before the union of the two sides of the body along the anterior mesial line, or rather perhaps before the sides are formed, the heart lies nearly in contact with the lower part of the head, the neck being extremely short, and the body curved forward; yet we must think the presence of the thymus gland and lungs in the same situation, completely disproves M. Breschet's supposition. The lungs do not make their appearance till the branchial clefts are declining, at which time the neck elongates, and the heart assumes its place in the thorax, so that the lungs are at no period naturally placed in the position assumed in this monster. The thymus gland is even still later in its formation.† How far the diaphragmatic hernia may have operated in effecting this change of position, it is difficult to say, but we feel inclined to attribute some influence to this cause. Walter‡ met with a case in a new born lamb, in which the heart occupied another position in the neck; it was placed with its base towards the thorax and without the pericardium, in the lower part of the neck, whence it gave off its vessels as usual.

It would be an almost endless task, to enumerate all the varieties of position, which the parts of the heart may assume in relation to each other; we must therefore content ourselves with

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* Rép. Gén. d'Anat. T. ii. p. 24.

† Rathké in the Rép. Gén. d'Anat. &c. T. vii. p. 37, and Dr A. Thomson, Edin. New Phil. Journal, January 1831, p. 74.

‡ Mus. Anat. Descriptionis continuat. prim. ex Catalogis Walteri Autographis ab Rudolphio instit. p. 3102.

mentioning a few of them. With respect to the mode of formation of many of these, we are too much at a loss to offer even a conjecture.

In a case dissected by Dr Holmes* of Canada, and communicated by Dr Alison to the Medico-Chirurgical Society of Edinburgh, the right auricle was found to open into the left ventricle, in place of the right. The only means by which the blood could enter the pulmonary circulation, was in this instance, through a small perforation in the septum of the ventricles. "The preternatural orifice between the right auricle and left ventricle was large, and furnished with valves similar to the tricuspid."

The aorta and pulmonary artery, are not unfrequently malplaced. We have already noticed, the communication of each of these vessels with both ventricles at once, by means of the imperfection of the septum near their roots; in other cases, we find them both opening into one of these cavities only. In the Museum of the College of Surgeons of Edinburgh, there is an example in which the aorta and pulmonary artery communicate only with the left ventricle, and another in which they both rise in a similar manner from the right. Of this latter deviation, two other cases are also on record.†

The *ductus arteriosus* rarely wanders from its natural situation. The instance we have before alluded to, in which it opened into the left subclavian artery, is among the most interesting of its deviations.

Malposition of the pulmonary or systemic veins, is generally found in conjunction with considerable malformation of the heart itself. The right pulmonary vein in such cases, frequently opens into the *cava superior*;‡ and the left into the left subclavian vein.§ There is sometimes a pulmonary vein for each auricle,‖ and the right has even been found passing through the diaphragm, and opening into the *vena portarum*.¶ When

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* Trans. of Med. Chirurg. Soc. of Edin. Vol. i. p. 257.

† Arch. Gén. de. Méd. T. xxiii. p. 511. and Med and Phys. Journal, Vol. lxi. p. 548.

‡ Meckel, Dissertat. Inaug de Cordis, &c. p. 19.

§ Med and Phys. Journal, Vol lxi. p. 548.

‖ Rép. Gén. d'Anat. &c. T. ii. p. 9. Plate I.

¶ Med. and Phys. Journal, Vol. lxi, Loc. cit.

the *venæ cavæ* are double, the right will sometimes open as usual, while the left empties itself into the left auricle. *

We now come to those cases of malformation in which the heart, though placed in the chest, does not occupy its natural situation there. Cases of this species of exposition, though of pretty frequent occurrence, from the very slight inconvenience they occasion, have received comparatively little attention. Some of them appear to depend on arrestment of developement; others on displacement from hernia, or tumours in the neighbourhood; and others again on morbid adhesions. Some of these congenital errors of position, are very similar to those into which the heart is sometimes driven by diseases of the pleura or lungs, or even by certain organic lesions of the heart itself; and might therefore mislead the physician, if the possibility of their occurrence as malformations, was not borne in mind.

The direction of the apex of the heart to the right side, and the situation of the whole organ more or less to the right of the mesial line, is among the most common of the situations occupied by the heart, when out of its usual place. Breschet † has himself seen the heart on the right side four times, and refers to Otto, ‡ Moellenbrock, § Mohrenheim, ‖ and Elvert, ¶ for similar cases, and these too, unconnected with the transposition of any other viscus. Dr Ramsbottom ** has lately given an instance, of the point of the heart on the right side; and Sandifort, Morgagni, Haller, Meckel, and many others, have witnessed like cases.

The location of the heart in the centre of the thorax, has been met with occasionally. Breschet †† has described one case, in which it was placed directly in the centre of the chest, but with the apex slightly turned to the left side. This is a malformation we may fairly attribute to arrestment of developement,

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* Rép. Gén. d'Anat. Loc. cit.

† Ibid. T. ii. p. 6.

‡ Handbuch der Pathol. Anat. des Menschen und der Thiere, 1814.

§ Miscell. Natur. Curious. Dec. i. Ap. Obs. 76.

‖ Wiener Beiträge, &c. Prakt. Arzneyk, T. ii. p. 305.

¶ De Phthisi Pulmon. in viro cui cor in dextro pectore pulsabat, 1788.

** Med. and Phys. Journal, Vol. lxi. p. 548.

†† Rép. Gén. d'Anat. T. ii. p. 7.

as Meckel describes the heart nearly in that position in the human embyro, as late as the ninth week.

The horizontal and transverse positions are said to have been assumed by the heart, but they are of rare occurrence as congenital malformations; and indeed it seems doubtful, whether the effects of disease may not have been mistaken for such. Bertin * figures a heart lying transversely in the chest, but its malposition was dependent on a large aneurism of the aorta, and extensive disease of the heart itself.

Ignatius de Torres † relates an extraordinary case, in which he says he observed "in a new-born female infant, the heart without a pericardium, and turned upside down, so that its basis, with all the vessels, had fallen down as low as the navel; and its apex, still on the left side, lay hid between the two lungs."

In the University Museum here, ‡ is an instance of congenital displacement of the heart from imperfection of the diaphragm, "through which the stomach and spleen, with almost all the intestines, had passed into left cavity of thorax, displacing the heart, and impeding respiration."

Transposition.—Our second class of malpositions, or that of transposition, consists of only two species, as far as we have at present been able to ascertain. In the first, the heart is completely transposed, so as to occupy, on the right side, a situation in almost every respect similar to that which it usually holds on the left. In most of these cases the aorta makes a like turn, and passes down on the right side of the spine, § while the right lung presents the characters commonly found in the left. ‖ The transposition of the aorta is not, however, a necessary consequence of transposition of the heart. In a celebrated case, of which Mr Abernethy ¶ has given the history, the aorta, though making its turn to the right, and giving off an *innominata* or brachio-cephalic trunk, to the left, regains its natural position before it becomes the abdominal aorta. The aorta, too, may be transposed when the heart is not affected. In the case we have

* Traité des Maladies du Cœur, &c. 1824, p. 103.
† Phil. Trans. Abrd. Vol. viii. p. 509.
‡ Cat. of Anat. Mus. of Univ. of Edin. p. 244.
§ Rép. Gén. d'Anat. &c. T. ii. p. 7. Pl. 1, Fig. 1.
‖ Arch. Gén. de Méd. T. xviii. p. 82.
¶ Phil. Trans. 1793, p. 60.

beforementioned, in which the heart was in the centre of the chest, the abdominal aorta was on the right, though the arch turned to the left; and in a case figured by Cruveilhier,* the heart is placed quite naturally, though the aorta through its whole extent is directed to the right side. The disposition to transposition, is not confined to the vascular system; the stomach and spleen frequently occupy the right hypochondrium, while the liver often takes its place in the left. On what this extraordinary change can depend, we know not; nor indeed can we expect to know, till we have ascertained why the aorta in mammalia occupies the left side, and why in birds the right is preferred.

The second species of transposition, is perhaps still more extraordinary; it consists in the transposition of the aorta and pulmonary artery; the aorta taking its rise from the right ventricle, the pulmonary artery from the left. Baillie † was the first to describe a case of this kind; since that, M. Professor Dugés has seen the same malformation in France; ‡ a similar case is also preserved in the Museum of the College of Surgeons of Edinburgh, and another in the Museum of Guy's Hospital, London. § The fact is therefore incontestible, inconsistent as it may appear with all laws of formation, incompatible as it is with the existence of the individual. It would be impossible to give any rational explanation of this, as well as many other of the malformations here collected. We do not, however, despair of seeing the day, when all these will be as easily understood as those of arrested developement; nor do we think that those who know how very lately it is, since the explanation of even these facts could have been given, and who recollect how many active minds are now engaged in the pursuit, will believe us too sanguine in the hope we have expressed.

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* Anatomie Pathologique du Corps Humain, Livraison 1.re, Pl. vi. There are some peculiarities in the distribution of the vessels to the lungs, in this case which appear quite anomalous. Were it not for the high authority on which they are given, we should be inclined to suspect some error, and consider them rather as varieties of the bronchial arteries, and quite unconnected with the pulmonary circulation.

† Morbid Anatomy. 1830. P. 36.

‡ Arch. Gén. de Méd. T. xxii. p. 232.

§ Cat. of Anat. Mus. of Guy's Hospital, No. 1392.

Part III.

Pathological Effects, Symptoms and Treatment.

Such, then, are the chief congenital malformations, hitherto noticed in the anatomy of the heart; and such the principles, on which we conceive their developement depends.

By what changes of structure are they attended, and by what signs are they to be recognized? We shall proceed to answer these questions, by some considerations on their pathology, symptoms, and diagnosis.

It must be evident, that many of the malformations we have described, are so little adapted to perform the functions required of the parts, as to be incompatible, with even a temporary independent existence;—Acardia is a manifest illustration: while others may be present without ever causing the slightest inconvenience;—some of the species of malposition are of this class: and both of these may therefore be dismissed for the present. Those which remain, varied as they are in form, with respect to function, resolve themselves into one, differing only in degree. The admixture of the black and red blood, and the impediment offered to a free circulation, are the common effects of all, to which the whole train of symptoms may be more or less directly referred. It is to the consideration of these we shall now confine ourselves.

Pathological Effects.

Before entering into the description and theory of symptoms, it may be as well to notice, some of the *morbid changes of structure* in the various parts of the heart, which are often found in connection with congenital malformations; and some circumstances in the history of these changes, which have led to doubts as to the period of their formation. In the nineteen cases collected by M. Louis,* there were ten instances of diminution of the orifice of

* Observations suivies de quelques Considérations sur la communication des cavités droites avec les cavités gauches du cœur, par M. Louis, Arch. Gén. de Méd. Tome iii.

the pulmonary artery, while it occurred only once in the aorta. Disease of the tricuspid valve, is more common than of the mitral; but both are rare. In the cases already quoted, dilatation of the right auricle was observed in eighteen; five times with hypertrophy, and twice with atrophy of its parietes. The right ventricle was dilated nine times; and in four of these it was also hypertrophied. Simple hypertrophy of the walls of this cavity occurred in six others. On the left side, dilatation of the auricle was seen eight times; of the ventricle, four. Hypertrophy of the former, is mentioned in three instances; of the latter, in two only. It must strike every one that these appearances, as hypertrophy, retraction of the orifices by deposition or union of the valves, &c. are so analogous to other independent morbid states of the heart, that there can be little doubt that they must arise from similar causes, and are frequently formed long after birth. They have, however, in other cases been found at so early an age, as to be attributable, only to a morbid action prevailing during the period of fœtal developement. To the latter, must we refer many of those instances terminating fatally soon after birth; to the former, those which show themselves only at a later period.

This leads me to one of the most extraordinary circumstances, in the history of the disease under consideration. Many of the subjects of malformation of the heart have lived for sixteen, twenty, or many more years, without betraying any striking symptom of the presence of such affection; and this has led to a doubt, whether the malformation has existed, previously to the occurrence of the train of symptoms, by which it is usually known. Most of the cases in which such a doubt is admissible, will be found to consist of simple communication of the cavities, by perforation of their *septa;* and in these instances we think, the causes of this apparent anomaly may be made sufficiently obvious.

Laennec * conceives that the narrow oblique opening which is often seen between the plates of the valve of the *foramen ovale*, though preventing any admixture of the venous and arterial blood, is often the cause of a more serious affection; since by a violent blow or sudden effort it may easily become dilated, and then

* Laennec on Diseases of the Chest, &c. Translated by Forbes. 1829. p. 630.

progressively enlarged. A case related by Corvisart,* is generally cited, as most strongly confirmative of this opinion. A postilion, aged 57, who is not said to have shown any previous indications of diseased heart, was attacked with dyspnœa, palpitation, &c. &c. after a severe injury from a carriage passing over him, and a violent blow in the epigastrium. He continued for three years, to present, with alternate accessions and remissions, the same symptoms; and after death, exhibited a *foramen ovale* an inch in diameter; dilatation of the right auricle, with dilatation and hypertrophy of the right ventricle. In other cases, the symptoms have first showed themselves, after violent fits of coughing; as in *pertussis*, or other pulmonary affections.

The following considerations induce us to believe, that such causes can operate but very seldom, if ever. Cases are known, in which the *foramen ovale* has been pervious, or the *septum ventriculorum* imperfect, though no indication of such formation was ever present during life, and the fact itself only discovered after death. The absence of symptoms, therefore, does not entitle us to conclude that congenital malformation may not exist.† It is not difficult to account for this seeming anomaly. As long as the circulation remains tranquil,—the lungs continue healthy,—a free passage exists through the pulmonary artery,—and the two sides of the heart maintain their natural proportions;—even though there is an anormal communication between the two cavities, little blood will pass through it. For we must remember, that the fibres of the heart, contract in such a direction as to urge the current of the blood, rather in its natural course, than to any other channel; and also, that an equal power, (relative to the force required,) is exercised on either side, and, therefore, the inclination of the fluid to pass from one side to the other, is equally opposed. But only let this balance of the circulation be destroyed; let more blood be sent to the right side of the heart by emotion, or exercise; or from disease let congestion take place in the lungs; and the accumulated mass of blood, stimulating the heart to increased action,

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* Corvisart, Op. Cit. p. 279.

† Of the former case, I have myself lately seen an instance in the Royal Infirmary Edinburgh, the subject of which died of Icterus. The heart was otherwise quite healthy.

is driven to seek an outlet where it may, and at once passes through these anormal openings.

From the augmentation of the *mass* of the fluid, the cavities, especially the auricular, soon become dilated; while by the *increased action*, according to a general law in the developement of muscles, increased growth or hypertrophy * is produced.

In opposition to the opinion maintained by some, that the communications between the ventricles are the effect of ulceration or rupture, we may urge, that the edges of the openings are mostly smooth and tendinous, not presenting the thick and rugged surface of ulceration, nor the ragged fibrous appearance of rupture; that they are not preceded by the inflammation, which must be the forerunner of an ulcer, nor is the death so sudden as it would be, if the heart was ruptured. † If we observe, too, the situations in which the openings generally occur; we shall find them at the upper and posterior parts of the interventricular septum, parts which, from their being last formed, are known to be most subject to retardment of developement, but which are least likely, for the occurrence of ulceration or rupture. ‡ If to these it be added, that in cases which from birth have shown indications of the disease, we find exactly the same appearances, as in those apparently affected only a few months before death, we shall have, I think, sufficient reason to conclude, that these malformations are almost always of congenital origin.

Symptoms.

The symptoms exhibited by congenital malformations of the heart arrange themselves naturally enough under the respective functions, of circulation, respiration, and nutrition; and it is in this order we shall treat of them.

Circulation.—The physical signs to which the action of the heart gives rise, and which are appreciable by mediate aus-

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* The opinion of Corvisart, that the hypertrophy of the right side depends on the entrance of arterial blood into its cavities, and was caused by its more stimulating qualities, is not tenable. Some would be inclined to attribute it to the effect of inflammation, but we do not see why the heart should not follow the same laws of developement as the voluntary muscles; nor do we think there are any facts which contradict it.

† Bertin, Traité des Maladies du Cœur, &c. p. 395.

‡ Bertin, p. 394, and Andral, Anat. Pathol. T. ii. p. 307.

cultation, are unfortunately almost unknown with reference to our present subject. Laennec himself had but little opportunity of trying its effects; and by later authors, its use in such cases has been much neglected. As the blood, however, in its natural course, gives certain manifest signs, it is but fair to believe that our improved knowledge of the means of investigation, and their careful application, will enable us to detect some changes, caused by such striking deviations from that course. The contraction of the orifices, very frequently complicated with congenital malformation, is indicated by the *bruit de soufflet*,—according to Elliotson; * and may consequently be expected in such cases. This symptom is mentioned by Laennec, Louis, and others, † but it is probable that in all these cases, it depended only on the cause just assigned. The dilatation and hypertrophy of the right side, the symptoms of which are pretty well established, are much more rare than on the left, except when combined with malformations, and will therefore of course help us in our diagnosis. Frequent palpitations on slight exertion, is a symptom very common in these affections, and on careful inquiry is generally found to have existed from birth, though perhaps little noticed. When the disease has fairly established itself by the morbid formations already described, the patient is liable to severe paroxysms of dyspnœa, during which, palpitations are very apt to occur, though the heart's action may be sufficiently regular at other times. It is subject, however, to great variety in this respect. In one we find "the action of the heart strong, but felt only at intervals," ‡ in another so strong as to be seen at a distance, § while in a third it is so weak as scarcely to be perceived. Corvisart || in one instance, mentions that "la main, placée sur la région du cœur, sentait un battement peu régulier, accompagné d'un *bruissement* particulier trés-rémarquable." There was here absence of one of the aortic valves, on which this phenomenon probably depended.

The pulse is scarcely more certain in its indications. When

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* Elliotson, Diagnosis of Diseases of the Heart, folio. London, 1830. p 13.

† Laennec, p. 628 and 629, Louis, Arch. Gén. de Méd. T. iii. p. 332.

‡ Dr Abercromby's Contributions to the Pathology of the Heart, Edin. Med. Chirurg. Trans. Vol. i. p. 59.

§ Dr Hunter, Med. Observ. Vol. vi.

|| Corvisart, Op. Cit. p 276.

the body is at rest, the pulse is frequently quite natural. During the paroxysm, it is in some intermittent, in others regular; in some strong and full, and again in others almost imperceptible. It is not always synchronous with the heart; * perhaps irregularity is its most general character. It should be understood, that we do not consider these changes in the circulation to depend on the original malformation, but to arise rather from the subsequent disease of other parts of the heart.

From the congestion, which we have already stated to be one of the effects of these malformations in their later stages, hemorrhages are of frequent occurrence. These mostly proceed from the nose or gums, sometimes from the stomach, intestines, or lungs. It has been noticed in the lungs particularly, when combined with tubercles there. † These hemorrhages are generally trifling, and not as some have supposed, the immediate cause of death in most instances.

The changes in the state of the brain and mental functions, probably dependent on some alteration in the cerebral circulation, are headach, vertigo, and excessive irritability of temper. Farre ‡ includes also, torpor of the brain, epilepsy, apoplexy, paralysis, and syncope. Of these latter, the first may be seen in cases of partial idiocy, but would rather come under the head of nutrition; the three next do not appear to be of frequent occurrence, and are rather coincidences than effects, while the last we are inclined to consider misnamed. Instead of syncope, dependent on an imperfect supply of blood by the arteries, and attended by paleness of the surface, want of action in the heart, &c. &c. it is probably asphyxia, arising, according to Bichat, from the transmission of black blood through the brain. It is certainly attended with most of the appearances usually seen in such cases.

The torpor of the brain is sometimes observed in common with that of other parts of the body, and seems to owe its origin to the defective stimulus afforded by the black blood with which the arteries are filled.

Irritability of temper is quoted by Corvisart § in a case from

* Corvisart, Op. Cit. p. 277.

† Louis, Arch. Gén de Méd. Tome iii. p. 331, and Farre, p. 34.

‡ Farre, Op. Cit. p. 33.

§ Corvisart, Op. Cit. p. 294.

M. Caillot, among others, and appeared to have been present from birth. It is often very strongly marked, and frequently induces the recurrence of the paroxysm.

The palpitations and disturbance to the circulation, in many instances, seem to be influenced by the state of the stomach. In some, the simple distension of the part will explain the impediment offered to the heart's action, but in others, according to Nasse, * it arises from indigestion, and is variously affected according to the nature of the food taken.

The pulsation of the jugulars, though noticed but rarely, is probably a very common symptom, from the frequent occurrence of dilatation of the right auricle.

Respiration.—The symptoms referrible to lesions of this function, are among the most important the disease presents. The breathing is habitually short and difficult,—easily excited by slight exertions, or violent mental emotions,—and often terminating in dreadful paroxysms of dyspnœa. During this state, the sense of suffocation is intense; the body is slightly convulsed; the surface turns of a dark purple colour, and colder than natural. The eyes now become prominent, the face bloated, the jugulars turgid, the respiration deep but seldom with occasional screaming, the *decubitus* forward or abdominal, till at last the patient sinks down insensible, and scarcely seems to breathe. The paroxysms † sometimes occur periodically, and are frequently the immediate cause of death. Their duration is very various, from a few minutes to several hours. Patients generally recover from this state with a sigh or yawn, and even when it has been most severe, express themselves much more relieved than before its occurrence. ‡ How is this symptom to be explained? Mr C. Bell § has supposed, that, as during the occurrence of the fit, the patient either leans forward, lies on the belly, presses the breast against something hard, or supports the abdomen with the hands; and as, from assuming the decumbent posture, the fit has been put off; ‖ therefore,

* Reil's Arch. für die Physiol. Vol. x. p. 276.

† Duncan's Medical Commentaries.

‡ Corvisart, Op. Cit. p. 277.

§ Anatomy and Physiology of the Human Body. (6th Ed.) Vol. ii. p. 72.

‖ "Any hurry upon his spirits, or brisk motion of his, would generally occasion a fit. And for some of the last years of his life, he has found out, by his own obser-

this state depends on a want of pure air in the lungs, and this effort is made to contract the cavity of the chest, and expel as much as possible of the impure air. When this is as far as possible accomplished, continues the same author, the sigh or yawn, by which the recovery is preceded, again fills the lungs, and the patient finds himself suddenly relieved. But it is not in the lungs the disturbance first commences, and though first manifested by this organ, it is probably only from sympathy with the brain it is affected. The causes usually exciting the paroxysm, are such as increase the rapidity of the venous circulation, and consequently overload the right side of the heart with blood; which in these malformed hearts is immediately transmitted unchanged to the left side, through the anormal communication. Hence, the blood passes forward to the brain, and produces complete or partial asphyxia; till at last the circulation again becomes equalized, and a sufficient quantity of oxygenized blood gains the left side, (for some portion still continues to pass through the lungs,) when the organs again receiving their proper stimulus, again resume their natural functions. The peculiar posture is chosen probably, as the upright in ordinary cases of dyspnœa, to allow the more easy passage of the blood from the lungs to the left side of the heart, whereby the former organ is relieved; while the fits have been put off or mitigated by lying on the belly or side, merely, as we believe, because in that position the body is most completely at rest, and the circulation becomes soonest tranquillized.

From the imperfect manner in which the blood is oxygenated, or rather from the small quantity of it submitted to the action of the lungs, two other effects arise,—the *cyania*, *cyanose*, *morbus cæruleus*, or blue jaundice, (for by all these names has it been called,)—and an unnaturally low temperature of the surface.

M. Caillot, in an essay on this subject, was the first who traced the connection, which exists between certain malformations of

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vation, that when the fit was coming upon him he could escape it altogether, or at least take considerably from its violence or duration, by instantly lying down upon the carpet on his left side, and remaining immovably in that position for about ten minutes. I saw the experiment made with success."—Dr Hunter in Med. Observ. and Enquiries, Vol. vi. p. 301.

the heart, and a blue colour of the skin. This connection, he considered to depend on the transmission of the blood to the left side of the heart, and thence through the arterial system, without having previously undergone the influence of the pulmonary circulation. For some time, this opinion was generally received by the medical world, till Louis, Bertin, and others denied its correctness, and attributed the appearance to another cause,—congestion.

We shall then examine their arguments, and endeavour to determine how far they are correct; first, however, stating to what we consider this phenomenon attributable. There are two causes, the co-operation of which is necessary to constitute the most marked form of the affection;—1*st*, The circulation of black blood in the arteries, and 2*d*, Congestion in the whole capillary system. The first of these causes, we have already said, depends on the anormal state of the heart itself; the second, either on a want of stimulus afforded by the unoxygenized blood, or, as is more probable, from congestion in the veins, arising from the frequent accompanying disease,—contraction of the orifices of the heart.

It is argued, that CYANIA does not depend on the circulation of black blood,—because this symptom is not present in all cases of anormal communication; because it is not peculiar to these cases; because the blue colour is not general; because it is never present, except where there is contraction of the orifices causing congestion;—and lastly, because the colour of the fœtus at the birth is not purple.

We have already shown, that these malformations may exist from birth, without allowing this mixture of the two sorts of blood; and therefore it is no argument, that *cyania* does not always accompany them.

That the purple colour of the skin is not peculiar to such affections, is true only to a certain extent. In dilatation of the cavities of the right side of the heart,—in contraction of the orifices of that part,—in hepatization or emphysema of the lungs,—in spasmodic asthma,—or in hooping-cough,—in short, in all diseases impeding the circulation, and respiration, the skin becomes of a darker colour than natural. But it is on the extent to which this prevails, that the importance of the appearance as a

diagnostic in this disease depends. The colour is in general much darker than in any simple congestion;* much more universal; much more constant; and frequently extending to the brain and other viscera. This statement is borne out by the very first case, quoted by M. Louis† himself, and still more so, by another from Caillot‡; "les téguments de la face, de la poitrine, et des membres, étaient d'un violet tirant sur le noir; les intestins et les autres viscères abdominaux d'un brun foncé. A peine pouvait on distinguer dans le cerveau le substance corticale de la médullaire."

The statement, that cyania is only present where there is contraction of the orifices, or dilatation, producing congestion, is contradicted by the case of transposition of the aorta and pulmonary artery already cited from Baillie,§ where the heart "had nothing else remarkable in its structure," but where "the child had a most unusually livid skin."

The last argument, originating with M. Fouquier, that the fœtus, which circulates only black blood, has not a blue skin, requires some consideration. In the *first* place, the colour of the fœtus at birth and for some days after, is darker than at a later period;‖ and, *2d*, though it has been stated by Bichat,¶ and others after him, that the colour of the blood in the umbilical arteries and veins is uniformly dark; yet we are justified in disputing this opinion, great as is the authority, as well from reasons drawn from analogy, as from the positive experience of other authors. In alluding to this subject, Bostock** observes, "I cannot but feel surprise at such an opinion, as in some cases where I have had

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* I know of only two cases, which seem to contradict this. They are recorded by Dr Thomson in the 12th Vol. of the Ed. Med. and Surg. Journal. In both the blueness is said to have been general, and in both it apparently arose from suppression of the catamenia, after exposure to cold.

† Arch. Gén. de Méd. T. iii. p. 326.

‡ Bulletin de la Faculté de Méd. année 1807, p. 21.

§ Baillie's Morbid Anat. p. 36.

‖ I have more than once observed in attending deliveries many years ago, tha the fœtus had at first exclusion a dull dingy colour, but the moment it began to cry lustily, it immediately assumed a vivid red colour.—Ed. of Edin. Med. and Surg. Journ.

¶ Bichat, Anat. Gén. 1801. T. ii. p. 343; and Magendie's Comp. of Physiol. by Milligan, p. 505. &c. &c.

** Bostock's Elementary System of Physiology, Vol. ii. p. 199, note.

an opportunity of examining the fœtus immediately after its extraction from the uterus, the different colours of the blood in the funis appeared quite obvious, thus agreeing with the observations of Dr Jeffray; De Placenta, p. 41." To this we may add the still more recent authority of Dr Holland. * "From the kindness of my friend Mr Carr, surgeon, Sheffield, I have been enabled to prove, by an experiment of the simplest kind, that the umbilical vein circulates arterial blood."—"But on taking part of the cord, as soon as the child was born, around which I had previously tied a ligature, about two or three inches from the free extremity, and cutting this with a sharp scalpel, in order to make an even surface, I very clearly discerned, on pressing the cord from below upwards, blood of a very different colour, flowing from the umbilical veins and arteries."

That cyania does depend then principally on the circulation of black blood in the arteries, we maintain, because, as the colour of any organ is partly derived from the blood it contains, a change in the colour of the blood must affect the colour of the organ; and because in these cases, the colour is deeper, more diffused, and more constant † than in any other.

In most of the cases recorded with any degree of care or minuteness, a great sensibility to cold, as well as a diminished temperature of the extremities or surface generally, has been particularly noticed. This symptom is aggravated by cold weather, and during the paroxysm of dyspnœa, while it is relieved by rest, coverings of flannel, and the warm bath. Nasse and Farre seem to have been the first who thought of ascertaining by the thermometer to what extent this variation proceeded, and in the small number of cases in which it was tried, were surprised to find the temperature of the internal parts maintaining its usual elevation, while on the external it varied consider-

* The Physiology of the Fœtus, Liver, and Spleen. By George Calvert Holland, M. D. London, 1831. p. 154.

† There are three cases on record, (vid. Corvisart, p. 296, Arch. Gén. T. iii. p. 336, and Farre, p. 15.) which are exceptions to this remark, for in these, either the skin was constantly pale, or it was sometimes pale and sometimes purple during the paroxysm. In the first of these cases, the orifice of the pulmonary artery was very much contracted, and it is therefore equally inexplicable on any other supposition hitherto adduced.

ably, as much as from 74° to 98° Fahr. It would, therefore, appear, that it was rather a want of power to resist cold, than any diminution in the evolution of heat, on which this symptom depended. We have placed this under the head of lesion of the respiratory function, because it seems pretty certain that the evolution of animal heat, is intimately connected with the changes which the blood undergoes in respiration, however difficult or inexplicable this process may be.

Nutrition.—The integrity of any one function, may be perhaps justly said to depend, on the integrity of every other function, so intimate is the sympathy of the several parts of the human body. We do not, however, feel inclined to refer the defective nutrition observed in these cases of malformation, to so general a principle; it would seem to depend, rather on the anormal state of the blood itself, thus rendered unfit for its proper nutritive office. This symptom varies in degree, but is seldom altogether wanting. In some, it shows itself in a general weakness of the whole body; the patient has been confined to his bed from birth; the size is unusually small; the whole system appears torpid; and the senses are often imperfectly developed. Sometimes there is emaciation, * especially in the lower extremities; Dr Hunter, † when speaking of such a case, forcibly says, "and when I looked upon his legs particularly, I could not but think of the limbs of a wading water-fowl." In some cases the brain seems to have been but imperfectly formed, if we judge from the childishness or idiocy which often accompanies them; ‡ though in others, the intellectual faculties seem to have been unimpaired. § The male organs of generation in a case mentioned by Farre, ‖ showed no signs of puberty at the age of 22; in a more recent case, in a female of 20, the catamenia had never appeared; ¶ so that it appears probable that these organs suffer some retardment in their developement. Malforma-

* Dr Pulteney, (in the Med. Transactions of the Coll. of Phys. of London, 1785,) communicates a case in which the whole body was extremely loaded with fat. I do not know of any similar instance.

† Dr Hunter's Med. Observations, &c. Vol. vi. p. 300.

‡ Farre, p. 38. Johnson's Med. Ch. Review for December 1830, p. 230

§ Farre, p. 36.

‖ Ibid. p. 38.

¶ Med. Chirurg. Review, Loc. Cit.

tions of the fingers and toes have been observed by many authors. * These parts become, "clubbed or bulbous," rough with warty excrescences, and the nails large and incurved.

Scleroma, or binding of the skin, a peculiar disease of the subcutaneous cellular tissue, has been observed in children whose hearts were malformed, and M. Breschet, † as well as some of the Italian pathologists, have imagined they have traced some connection between them. We are inclined, however, to consider these cases rather as coincidences than as causes and effects.

If, to the symptoms already detailed, we add frequent severe pains of the chest and epigastrium, occasional diarrhœa, in some perspirations, and towards the conclusion, œdema of the face and extremities, I believe we shall have enumerated most of the important phenomena presented by congenital malformations of the heart.

On the subject of diagnosis little need be said after so long a catalogue of symptoms. Though it is true that few, if any of these, have not at times failed, yet there are generally a sufficient number of them, and these occurring in a certain relation, to establish the nature of the affection. In early childhood, diseases of the heart from any other cause than congenital malformation are extremely rare. At a more advanced age, when the symptoms have not been present, or at least not noticed from birth, the diagnosis becomes more difficult. The dark colour of the skin; the paroxysms of dyspnœa, easily excited, often periodical, terminating in asphyxia, and that again in sudden relief; the emaciation, or imperfect developement of parts; the sensibility to cold; the hypertrophy or dilatation of the right side of the heart; and the absence of disease in the lungs or other organ, which could account for any of the symptoms, are the signs on which we must chiefly rely, in determining the nature of such cases. It must, of course, be remembered that these symptoms are modified, according to the period in which the disease is seen. In the first stage, we have little more than unusual shortness of breath, emaciation, and occasional

* Journal Complém. T. iii. p. 301.

† Béclard, Anat. Gén. 1823, p. 153, and Craigie's Elements of General and Pathological Anatomy.

palpitations, with some darkness of the surface. In the second, when it becomes combined with other morbid states, we have the pain of chest, habitual dyspnœa, irritability of temper, frequent paroxysms, and constant purple skin; while, in the last, there is torpor of the senses, the colour almost black, œdema of the extremities, and speedy dissolution.

Treatment.

The treatment of these affections may be discussed in a few words; it can only be palliative. The chief indications appear to be, to remove any cause exciting the recurrence of a paroxysm, and to relieve it when present. The first indication is best fulfilled by absolute rest; low diet, but such as contains most nutriment in a small compass, that the stomach may not be distended; absence of any excitement to the feelings or passions; diaphoretics; and the enjoyment of a moderately warm, regulated temperature. The last, by the abdominal decubitus; frictions with flannel; or still better, the warm bath. To speak of the use of opiates, purgatives, and in the last stage, diuretics, is unnecessary. Farre * has ingeniously supposed, that the skin in these cases may, to a certain extent, compensate for the imperfect manner in which the respiratory function is performed; and it is by acting on this surface, he is inclined to think, we must expect to afford the greatest relief. From the well known sympathy between the liver and lungs, and from the capability of the former organ to take on vicariously the function of the latter, as established by Tiedemann, it is not impossible, that, by stimulating this viscus to increased action, some of the bad effects resulting from mal-oxygenation of the blood might be prevented.

Such, however, are but at best mere conjectures. For the present, we can only consider congenital malformations in common with many other organic lesions, among the *opprobria medica;* and must therefore content ourselves, with such palliative remedies as experience shall prove most efficacious.

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* Farre, Op. cit. p. 45.

FINIS.

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